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APPENDICITIS

BAYARD HOLMES

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BAYARD HOLMES, M. D.

SURGICAL EMERGENCIES

A TEXT-BOOK OF SURGERY FOR PRACTITIONERS OF MEDICINE

II.

A diagram of a loop of intestine showing the distribution of a branch of the superior mesenteric artery and the intimate relations of the branches of the portal vein. (Modified from Spalteholz.)

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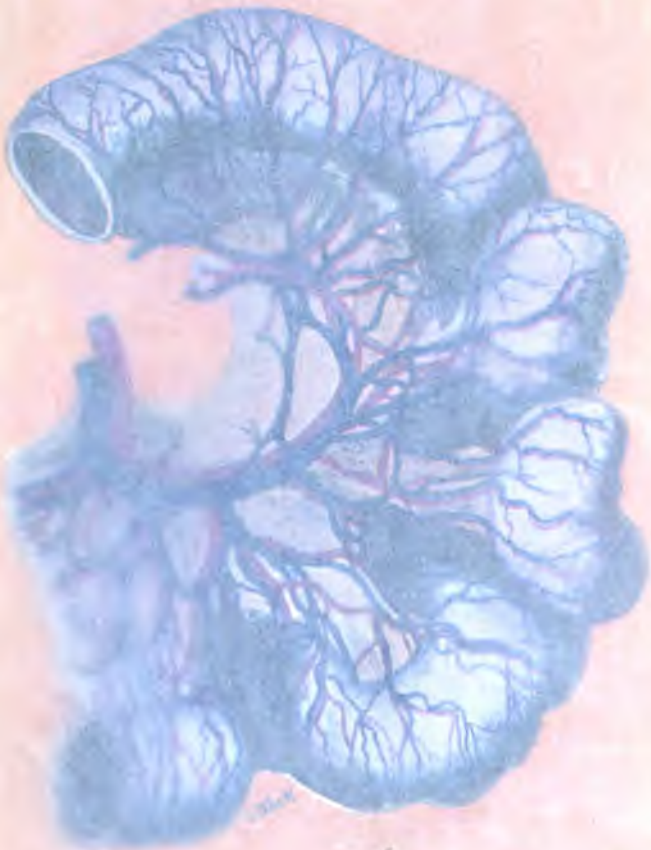

SURGICAL EMERGENCIES

THE SURGERY OF THE ABDOMEN

PART I.

APPENDICITIS
AND OTHER DISEASES ABOUT THE APPENDIX

BY

BAYARD HOLMES, B.S., M.D.

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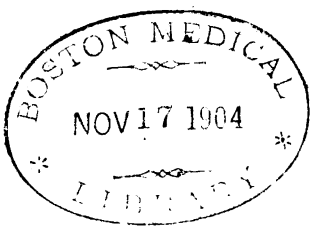

TABLE OF CONTENTS

CHAPTER I

PAGE

THE MODERN SURGICAL EPOCH. IMPORTANCE OF THE SURGERY OF THE ABDOMEN IN GENERAL AND HOSPITAL PRACTICE. THE CLINICAL FREQUENCY OF THE SURGICAL DISEASES OF THE ABDOMEN. SYMPTOMS OF ABDOMINAL DISEASE; VOMITING, CONSTIPATION, DIARRHEA, RIGIDITY OF THE ABDOMINAL MUSCLES, TUMOR OF THE ABDOMEN, TEMPERATURE, PULSE, LEUCOCYTOSIS. SUBJECTIVE SYMPTOMS. THE ROUTINE EXAMINATION AND HISTORY TAKING IN SUSPECTED ABDOMINAL DISEASE. THE IDEAL TRANSPARENT CLINICAL MANIKIN - - - - - 1–11

CHAPTER II

INTRODUCTION TO THE STUDY OF APPENDICITIS

HISTORIC NOTES; DEFINITION; TERMINOLOGY; APPENDICITIS AN ENTITY. THE RETENTION CYST. ANATOMIC CONSIDERATIONS. CLINICAL CONSIDERATIONS. NEGLECTED APPENDICITIS. THE SPREAD OF INFECTION - - - - - - - - - 11–57

CHAPTER III

OBSCURE FORMS OF APPENDICITIS

FAILURE OF CLASSIC SYMPTOMS IN MANY CASES; CHRONIC APPENDICITIS MANIFESTED BY REMOTE SYSTEMIC EFFECTS; BY GASTRIC DISTURBANCE; ILLUSTRATIVE CASES; BY RENAL SYMPTOMS; ILLUSTRATIVE CASE; BY THE TYPHOID STATE AND PULMONARY SYMPTOMS; ILLUSTRATIVE CASE; BY NERVOUS DISORDERS; ILLUSTRATIVE CASE - - - 58–76

CHAPTER IV

THE SYMPTOMATOLOGY OF APPENDICITIS PAGE

SUBJECTIVE SYMPTOMS; PAIN, NAUSEA, AND VOMITING; FAINTNESS; DIARRHEA AND CONSTIPATION; CHILL; HEAD- AND BACK-ACHE; GASTRIC DISORDERS; CUTANEOUS SIGNS; SOMNOLENCE AND INSOMNIA; NIGHT-SWEATS AND COUGH.

OBJECTIVE SYMPTOMS; POSTURE; TEMPERATURE; PULSE; LEUCOCYTOSIS; TUMOR; ABDOMINAL RIGIDITY; LOCAL TENDERNESS - - - - - 77–103

CHAPTER V

COURSE AND SO-CALLED COMPLICATIONS OF APPENDICITIS

DIFFICULTIES OF PROGNOSIS; DURATION OF THE DISEASE; ITS POSSIBLE COMPLICATIONS AND UNCERTAIN RESULTS; CASES; RELATIONSHIP OF ACUTE AND CHRONIC APPENDICITIS; GRAVITY OF BOTH CONDITIONS; LIABILITY TO RECURRENCE; FUTILITY OF ALL SAVE OPERATIVE MEASURES; INDICATIONS FOR TREATMENT; PRESENT TENDENCY IN TREATMENT; DANGERS OF DELAY; ILLUSTRATIVE CASES - 104–131

CHAPTER VI

DIAGNOSIS AND DIFFERENTIAL DIAGNOSIS OF APPENDICITIS

THE RESPONSIBILITY OF THE DIAGNOSTICIAN; THE DIAGNOSIS OF APPENDICITIS ALWAYS RELATIVE; THE IMPORTANCE OF THE HISTORY OF THE CASE. INSPECTION OF THE PATIENT; PALPATION; PERCUSSION; AUSCULATION; EXPLORATORY PUNCTURE; EXPLORATORY LAPAROTOMY; THE LABORATORY EXAMINATION. DIFFERENTIAL DIAGNOSIS; POSSIBLE METHODS OF CLASSIFICATION; THE CLINICAL METHOD. WHEN THE PATIENT IS A CHILD; ACUTE DILATION OF THE STOMACH; INTUSSUSCEPTION; TUBERCULOUS PERITONITIS; GASTROINTESTINAL INFECTION; PNEUMONIA; CALCULI IN THE KIDNEY OR URETER; TUBERCULOSIS

PAGE

OF THE DORSAL VERTEBRÆ; INFECTION OF MECKEL'S DIVERTICULUM AND THE URACHUS; SARCOMA OF THE MESENTERY; CYSTIC TUMORS OF THE KIDNEY; HERNIA; DISTENTION OF THE URINARY BLADDER; FOREIGN BODIES IN THE INTESTINAL TRACT. WHEN THE PATIENT IS A YOUNG ADULT; CHOLECYSTITIS; MUCOUS COLITIS; ULCER OF THE STOMACH; TYPHOID FEVER; TUBERCULOUS PERITONITIS AND MILIARY TUBERCULOSIS; ACUTE PANCREATITIS; CALCULUS IN THE URETER; INCARCERATED HERNIA; GASTRITIS; GASTRODYNIA; GASTROINTESTINAL CATARRH; HYSTERIA; MALINGERING; UNDESCENDED RIGHT TESTICLE AND GONORRHEAL ORCHITIS; EMBOLISM OF THE SUPERIOR MESENTERIC ARTERY AND GANGRENE OF THE INTESTINE; UREMIA. WHEN THE PATIENT IS A YOUNG ADULT FEMALE; RUPTURED EXTRAUTERINE PREGNANCY; ABORTION; PYOSALPINX; PROLAPSE OF THE OVARY; OVARIAN TUMOR WITH TWISTED PEDICLE; TORT OF THE URETER OF A FLOATING KIDNEY. WHEN THE PATIENT IS AN OLD ADULT; CARCINOMA OF THE CECUM; CARCINOMA ELSEWHERE IN THE ABDOMEN; PROSTATIC PERIVESICLE ABSCESS; IMPACTION OF FECES - - - - 132–169

CHAPTER VII

THE TREATMENT OF APPENDICITIS

APPENDICITIS CALLS FOR APPENDICECTOMY; PERFORMED UNDER FOUR CONDITIONS. APPENDICECTOMY OF THE FREE APPENDIX; THE SIX STAGES OF THE OPERATION; THE PREPARATION OF THE PATIENT AND INSTRUMENTS; THE LAPAROTOMY; THE DISCOVERY OF THE APPENDIX; THE LIGATION OF THE MESENTERY AND THE REMOVAL OF THE APPENDIX; THE CLOSURE OF THE LAPAROTOMY WOUND; THE PROTECTION OF THE WOUND AFTER TREATMENT; ILLUSTRATIVE CASES. APPENDICECTOMY OF THE ADHERENT APPENDIX WITHOUT ABSCESS; THE DANGERS OF ENUCLEA-

PAGE

TION; THE APPLICATION OF THE TAMPON; THE REMOVAL OF THE TAMPON; ILLUSTRATIVE CASES. APPENDICECTOMY OF THE FREE OR ADHERENT APPENDIX WITH ABSCESS; THE DIFFICULTIES AND DANGERS OF THIS PROCEDURE; THE SECONDARY OPERATION; THE REMOTE CONSEQUENCES OF PERITYPHLITIC ABSCESS. THE ANESTHESIA FOR APPENDICECTOMY AND DANGERS OF ANESTHESIA; CONTRAINDICATIONS TO GENERAL ANESTHESIA. THE EARLY AND LATE OPERATION. CONCLUSIONS; BIBLIOGRAPHY - - - - - - - - - 170–241

CHAPTER VIII

PERITONITIS

FORMS OF PERITONITIS; PHYSIOLOGIC RESISTANCE OF THE PERITONEUM TO INFECTION; PERITONITIS A TERMINAL DISEASE, PREVENTABLE BUT NOT CURABLE; THE PERITONEUM A DISTENDED LYMPH SPACE; THE HISTOLOGY OF THE PERITONEUM; THE ANATOMY OF THE PERITONEAL POUCHES AND POCKETS; THE PHYSIOLOGIC PROBLEMS OF THE PERITONEUM; THE PAIN OF PERITONITIS; THE ETIOLOGY OF PERITONITIS, IDIOPATHIC, TRAUMATIC, CHEMIC, AND INFECTIOUS; THE SOURCES OF INFECTIOUS PERITONITIS; THE CLINICAL PICTURE OF PERITONITIS; THE COURSE OF PERITONITIS; DIAGNOSIS OF PERITONITIS; TREATMENT OF PERITONITIS - - - - - - 242–280

CHAPTER IX

INTUSSUSCEPTION

THE CONDITION DESCRIBED; RELATIVE FREQUENCY AS CONCERNS AGE AND SEX; ETIOLOGY; TYPICAL CASE; SYMPTOMS; DIAGNOSIS; PROGNOSIS; TREATMENT; THE OPERATION DESCRIBED; COMPLICATIONS; CASES; BIBLIOGRAPHY - - - - - - - - - 281–298

CHAPTER X

PERFORATED TYPHOID ULCER PAGE

INTRODUCTION; STATISTICS; RELATIVE FREQUENCY AND DANGER OF PERFORATION; SIZE, NUMBER, AND LOCATION OF OPENINGS; SYMPTOMS AND DIAGNOSIS; TREATMENT; METHODS OF PERFORMING THE OPERATION; STATISTICS OF OPERATION; ILLUSTRATIVE CASES; BIBLIOGRAPHY - - - - - - 299–318

CHAPTER XI

CARCINOMA OF THE INTESTINAL TRACT

STATISTICS OF CARCINOMA OF THE INTESTINAL TRACT; LOCATION; CLINICAL PICTURE OF THE DISEASE; SYMPTOMS AND FINDINGS; INDICATIONS FOR OPERATION; THE THREE SURGICAL PROCEDURES; CARCINOMA IN THE APPENDIX; BIBLIOGRAPHY - - 319–331

GENERAL BIBLIOGRAPHY - - - - - - 332–333
ADAGES - - - - - - - - - - 334–337
INDEX - - - - - - - - - - 339–350

LIST OF ILLUSTRATIONS

FIG.		PAGE
1	Curve Showing Age and Sex of Patients Operated upon in German Hospitals during 1894. (Arranged from Heimann.)	3
2	Cross-section of the Appendix of Mr. W. (Drawn by J. D. Blything.)	16
3	Cross-section of a Chronically Inflamed Appendix. (Drawn by J. D. Blything.)	17
4	Schematic Drawing of the Blood Supply of the Cecum and Adjoining Portion of the Ileum and Appendix	18
5	Dorsal View of the Ileocecal Region, Showing the Course of the Lymphatics and the Lymphatic Glands. (After Poirier and Cunéo.)	19
6	Ventral View of Ileocecal Region, Showing the Course of the Lymphatics. (After Poirier and Cunéo.)	19
7	The Histologic Structure of the Appendix. (From Testut.)	21
8	The Appendix in the Pelvic Fossa	23
9	The Appendix in the Ileocolic Fossa	23
10	The Appendix in the Retrocecal Fossa	24
11 12, 13, 14	Four Positions of the Appendix in the Retrocecal Mesentery. (After Huntington.)	25
15	The Appendix in the Ileocolic Fossa and over the Ileum	26
16	The Appendix behind the Ileocecal Valve	26
17	The Appendix Hanging over the Cecum	26
18	The Valve of Gerlach in an Infant One Month Old Dead of Accidental Disease	29
19	Segment of an Appendix in a Moderately Acute Attack	32
20	The Appendix of Mr. N.	36
21	A Partial Appendicitis	47

FIG.		PAGE
22	The Appendix of a Patient Suffering of Chronic Appendicitis, with Symptoms of Indigestion	63
23	An Appendix Cut Open, Showing an Obliterating Appendicitis	64
24	Cross-section of Appendix Showing Results of Chronic Appendicitis, with General Sclerosis of the Appendix. (Drawn by J. D. Blything.)	64
25	Outline of Skiagraph Showing the Stone in the Bladder and the Supposed Ureteral Calculus	82
26	Showing the Position of the Stone in the Vermiform Appendix	83
27	Diagram of the Arterial Supply of the Ileocecal Region. The Gamma Shows the Probable Site of Injury of the Ileocolic Artery in Removing the Enlarged Lymph Gland	120
28	Relation of Deep Epigastric Artery to Rectus Muscle	174
29	Section of Rectus and Abdominal Wall below Umbilicus	175
30	Section of Rectus and Abdominal Wall above Umbilicus	175
31	Semidiagrammatic Drawing Showing Conditions at End of Third Stage of Appendicectomy	177
32	Semidiagrammatic Drawing Showing Conditions at End of Fourth Stage of Appendicectomy	178
33	Diagrammatic Drawing Showing Inversion of Stump of Appendix	179
34	General Outline of Six-inch Artery Forceps Most Useful in Appendicectomy	187
35	Four Positions of the Appendix in the Retrocecal Mesentery. (After Huntington.)	192
36	Diagrammatic Representation of Process of Invagination	282
37	Semidiagrammatic Drawing Showing Ileocecal Intussusception	283
38	Semidiagrammatic Drawing of Intussusception	284
39	Map of United States Showing Relative Proportion of Deaths from Typhoid Fever in Different Grand Groups	301

LIST OF PLATES

NUMBER		PAGE
IA.	Diagram of a Loop of Intestine Showing the Distribution of a Branch of the Superior Mesenteric Artery and the Cognate Branches of the Portal Vein. (Modified from Spalteholz.)	Frontispiece
I.	The Ideal Manikin, with the Luminosities Calling Attention to Diseases of the Appendix	8
II.	The Ideal Manikin, with the Luminosities Calling Attention to Diseases of the Biliary Apparatus	16
III.	The Ideal Manikin, with the Luminosities Calling Attention to Diseases of the Kidneys and Ureters	24
IV.	Chronic (1) and Acute (2) Inflammation of the Appendix	32
V.	Semidiagram Showing Mesenteries of Colon, Small Intestine, and other Viscera after the Removal of these Organs	248
VI.	The Under, Caudal, Surface of Liver and Gall-bladder Showing Entrance to Lesser Peritoneal Cavity through the Foramen of Winslow	256
VII.	Half-tone from Photograph Showing Peristalsis above Obstruction in Case of Diffuse Peritonitis in the Caudal Peritoneal Cavity	272

PREFACE

The following pages contain the author's experience as corrected by the experience of other operators in the surgery of the most mournfully interesting and unique structure in the body. This little retrogressive organ is responsible for an unusual death rate among young and vigorous adults, and it breeds for others a series of nutritional and nervous disorders which makes it worthy the consideration of every practicing physician. It is impossible to contemplate the catastrophies incident to appendicitis without immediately viewing every abdomen from which the appendix has not been removed as containing a fuse and magazine which may be set off at any moment.

If the following pages contain an unusual number of unfavorable cases, it must be remembered that the horrible example is an effective device in teaching, and that it is pleasanter to learn from the disastrous experience of another rather than await the occurrence of similar catastrophies in one's own practice.

In a few instances the modern scientific nomenclature has been substituted for the medieval medical style. The most important innovation in this direction, and the only one which requires special mention, relates to the direction of the axes of the body. The words front and back are laid aside, and ventral and dorsal used in their places. The adverbs derived from these adjectives are ventrad and dorsad, meaning in a ventral direction and in a dorsal direction. Above

and below are not employed in the sense of toward the head or toward the foot, but cephalic and caudal are used in their places, and the adverbs derived from these adjectives are cephalad and caudad. The directions on the lateral transvere axis of the body are described from the central longitudinal axis of the body. Medial toward the central longitudinal axis on the lateral transverse axis, and lateral in a direction opposite this. Medad and laterad are such offensive adverbs that they are but rarely used.

It is difficult for the physician and the surgeon to view any case in the same perspective. The practicing physician is apt to be hopeful in his prognosis, no matter how grave the symptoms may be, or however inexplicable the symptom complex may appear. The consulting physician is apt to overlook the great law of probability in the immensity of possibilities which might explain the clinical picture in any difficult or serious case. He has in mind so many different pathologic rarities which have given rise to errors in diagnosis that he dwells upon remote possibilities, in a state of scientific indecision, until the positive findings of a necropsy or a protracted clinical observation reveals the true character of the disease. The surgeon is apt to dwell upon the probabilities of the case; he overlooks the rarities and the possibility of their confuting his diagnosis. He fears the destructive effects or the insurmountable catastrophies of delay. He hastens with a relative diagnosis to undertake the positive relief of the most probable condition rather than face the dangers of a delay sufficient to establish a positive diagnosis.

BAYARD HOLMES.

BOSTON MEDICAL
NOV 17 1904

CHAPTER I

The modern surgical epoch. Importance of the surgery of the abdomen in general and hospital practice. The clinical frequency of the surgical diseases of the abdomen. Symptoms of abdominal disease: vomiting, constipation, diarrhea, rigidity of the abdominal muscles, tumor of the abdomen, temperature, pulse, leucocytosis. Subjective symptoms. The routine examination and history taking in suspected abdominal disease. The ideal transparent clinical manikin.

In the surgery of the abdomen is found the most striking illustration of the progress of surgery and surgical pathology during the present pathologic era. This era began with the antiseptic treatment of wounds, inaugurated by Lister after Pasteur's demonstration in 1872 of the bacteriologic character of wound diseases. It is characterized by the autopsy in vivo, a proceeding that has added new fields to pathology and brought to light many common and threatening conditions which had never been suspected by the findings at postmortem examination. The preceding era was characterized by the careful study of the diseased body in the postmortem laboratory. Its keynote was sounded by Virchow in his Cellular Pathology, first published in 1852. The accumulated treasures of this period are contained in the journals of pathology beginning about 1840 and continuing to the present time.

In the preantiseptic period surgery lagged behind the development of pathology, while in the present antiseptic period it has been a constant and important factor in the advance of pathology. The quantity of material which it has contributed may not be voluminous, but it is of inestimable value. In marked contrast to this are the conditions that obtained prior to 1872. In order to form an idea of the character of surgery, and of the helplessness of the surgeon in preantiseptic times, one need but read the text-books of surgery published prior to 1875, or such monographs as those of Larry On Wounds, or that little literary gem of Dr. John Brown, entitled Rab and His Friends.

The importance of the surgery of the abdomen in the service of the ordinary practitioners of medicine is a factor difficult to estimate. Certain it is that very many cases requiring surgical treatment are now neglected. In the census reports on vital statistics the preponderance of the diseases of the abdomen is easily recognized, but the death rates, as published in these reports, hardly give to surgery that prominence to which it is justly entitled. In the Cook County Hospital for the year ending December 31, 1890, there were treated 8,214 cases, of which 3,813 were medical cases, and 4,401 surgical cases. Of these latter 333 were surgical diseases of the abdomen.

Heimann, in the 54th volume of Langenbeck's Archives, pp. 223–270, presents an interesting study of the reports from the various German hospitals to the Royal Statistical Bureau of Prussia. These reports were based upon the hospital work of 1894.

They comprise statistics gathered in 1,791 hospitals, with 85,846 beds, accommodating a total of 559,576 patients. There were 58,988 major operations performed during the year, or one operation to every tenth patient. Of these operations forty-four per cent were upon males and fifty-five per cent upon females. Of the total number of female patients sixteen per cent required operation, as opposed to only eight per cent of the total number of males. Operations were more common on young men and boys than on young women and girls, but were much more frequent on adult women than on adult men. This fact is illustrated by the following statistical diagram.

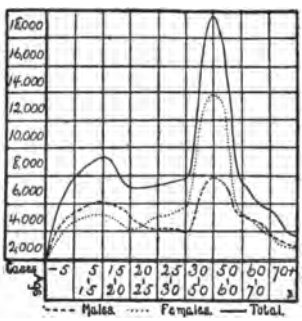

Fig. 1. Curve showing age and sex of patients operated upon in German hospitals during 1894. (Arranged from Heimann.)

There were 3,815 major operations performed upon the abdomen; 128 were exploratory laparotomies, of which 28 died; 266 upon the stomach, 119 died; 801 laparotomies for various disorders, 247 died; 220 intestinal resections were made, 77 died; 273 resections of the colon for carcinoma, 67 died; 103 operations were performed to produce an artificial anus, 50 died; 1,786 operations were performed for hernias of various kinds, 258 died; 236 operations were performed upon the liver, 27 died; 2 extirpations of the spleen were made, and 2 died.

These figures give data for some serious reflection.

About two per cent of the population of Prussia in 1894 were treated in the Prussian hospitals for some surgical disease. Of all deaths in Prussia five and seven-tenths per cent occurred in these 1,791 hospitals among two per cent of the total population. It is likely that not much less than six per cent of all sick received hospital treatment, the remaining ninety-four per cent being treated at home. If we assume that the same proportion of sick outside and inside the hospitals of Prussia required major surgical operations, then there ought to have been 320,000 major surgical operations done in the kingdom; and in the United States during the same year, with a population two and one-half times as great as that of Prussia, there probably was necessity for at least 800,000 major surgical operations, of which 60,000 should have been surgical operations upon the abdomen, not including the female genitals.

It is a significant fact, in view of the remarkable advance in abdominal surgery, and the correspondingly greater skill in diagnosis, that in these statistics for 1894 there are reported only 202 laparotomies for perityphlitis and ileus, with 89 deaths.

From an anatomic standpoint the abdomen presents problems of the greatest surgical interest. The head contains but one vital and essential mass, the brain. This organ yields but little to surgical interference or repair. It is covered moreover by an offensive and rigid bony capsule, the skull, the size and position of which is fixed and unyielding. Exploration of the brain is therefore a tedious, deforming, and relatively a dangerous process. When a large osteoplastic flap

has been made, but little can be done except to tie an artery or open an abscess.

The thorax contains but two vital organs, both of which are bad subjects for surgical manipulation. They are also inclosed in bony and membranous bulkheads, with an atmospheric pressure constantly changing and not for a moment in equilibrium with the external air. Palpation of the lungs or the heart requires the obliteration of one of these bulkheads, for there is no pneumatic caisson in which the operator may attach himself to the chest wall, and in which he may operate upon the lungs and heart without arresting their functions.

The abdomen, however, contains a dozen essential and somewhat movable organs, and invites surgical inspection and adventure by the ever-yielding and flaccid ventral and lateral abdominal walls. Nearly all the abdominal viscera are easily examined outside the abdomen, and all of them may be palpated and manipulated, incised, resected, or abbreviated. The abdominal wall is accommodating and allows the introduction of drainage, or falls forward and obliterates the cavities left by the removal of large tumors or abscesses.

At the present time diseases of the abdominal viscera present distinctly the most promising opportunity for surgical adventure. By far the most common affection calling for surgical interference in this region is appendicitis. It is a disease of such frequency that in comparison with it all others are rare. The most serious results follow its neglect, and the most distant and far-reaching complications attend its chronic

manifestation. The symptoms to which it gives rise are many and various, yet the diagnosis is in many cases almost absolute.

The second most common disease has its seat in the region of the gall-bladder, or the appendix of the liver. It appears rather oftener than most of us are prepared to admit, and its manifestations are as various as those of appendicitis.

The diseases of the kidneys follow naturally in the order of frequency, and later in life we have the new growths in the stomach and its outlet and the adjoining ducts, in the cecum, and in the various flexures of the colon.

There are a number of rarer abdominal diseases which require surgery, some of them being of the greatest pathologic interest.

It would be natural to consider the congenital malformations of the abdomen, the injuries of the abdomen, the diseases of the abdomen, and last the deformities which result from disease; but this is not the manner in which they are presented to the practitioner of medicine, and it may be advantageous to consider them wholly from a clinical standpoint. It is possible that the best introduction to the study of the surgery of the abdomen can be made by presenting the matter as it appears to one making a diagnosis of abdominal disease.

There are certain signals calling attention to abdominal disease, more or less common to all diseases of the abdomen. The most conspicuous and unfeignable of these is vomiting. It seems to be due in many cases to the shock which results from the arrest of

function of certain of the abdominal viscera. It is common in the beginning of appendicitis; it is frequent at the onset and during the course of biliary disease; it is conspicuous in every form of intestinal obstruction, whether it be complete or incomplete. It must be remembered, however, that it is a common event in conditions having no surgical significance, and that it stands as well for disease in the most distant organs of the body, for brain tumor, for suppuration of the nasal sinuses, for uremia and heart disease, and even so normal a condition as pregnancy.

Constipation and diarrhea are both common symptoms of abdominal disorders requiring surgical interference. The character of the stool is sometimes very significant, notably when it contains the ameba in abscess of the liver, or when it is stained with blood pigment as in duodenal ulcer, or when devoid of bile, as in obstruction of the common duct, or when charged with fat, as in obstructive disease of the pancreas. Not only the character of the stool, but its form, frequency, and the time at which the bowels move are often significant in the study of surgical diseases of the abdomen. Diarrhea is frequently a symptom of biliary disease, especially when it alternates with constipation; and again, it is often a symptom of disease of the appendix, though constipation is more likely to result from this latter condition.

The form of the abdomen and the rigidity of the abdominal muscles are of the greatest significance in determining the location and character of abdominal disease. If the abdomen is greatly distended, either by fluid or by gas, this may be unmistakably recog-

nized by palpation and percussion and by vaginal and rectal examination; or, under proper circumstances, by the dangerous process of abdominal puncture. When fluid is present in the abdomen, its relation to the viscera may sometimes be determined by shifting the position of the patient; and when a gaseous distention is present, its location in the general peritoneal cavity may be determined by the absence of the normal flatness of the liver or other abdominal viscera.

Tumors within the abdomen are easily palpated when the abdominal walls are relaxed by elevating the knees and bringing forward the arms by the sides, slightly raising the head and chest, and securing the utmost quiet, composure, and relaxation of the patient. In this manner so small an object as the stiff and enlarged appendix, or the distended gall bladder, or the thickened pylorus, or the enlarged kidney, may be easily palpated as the patient inspires and expires; and in bimanual rectal and vaginal examinations other visceral tumors, and even the normal uterus and ovaries, may be clearly made out.

Dyspepsia, indigestion, and gastritis, so-called, are a complex of symptoms which stand for various disorders within the abdomen. They are sometimes due entirely to disease of the appendix, of the biliary apparatus, or to infection within the kidneys.

The general symptoms of abdominal disease are not dissimilar to those of disease in other parts of the body. A rise of temperature, with a coincident rise of pulse, the presence of chills or rigors, a high leucocytosis, accompanied by peptonuria, and not infrequently the Diazo reaction, and a mild grade of albu-

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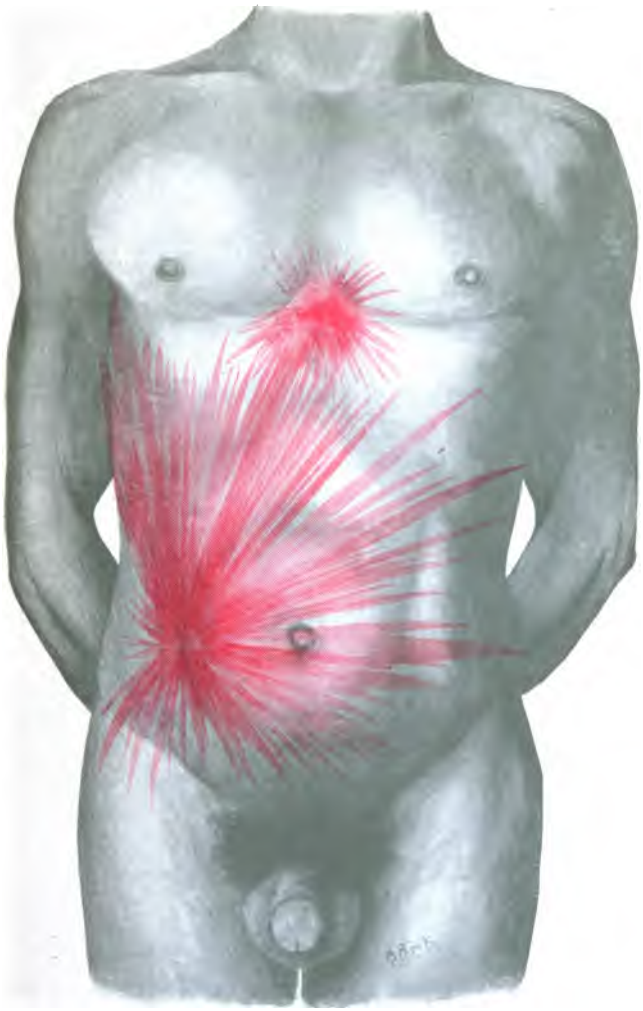


PLATE I

Ideal manikin, with luminosities calling attention to the appendix.

minuria with the findings of acute nephritis, are all symptoms of suppurative disease of pus microbe, coli communis, or pneumococcus infection. We are as yet unable to recognize the various toxines which are certainly present in the blood and urine in various forms of infection, but when the chemical pathologist shall have furnished us tests capable of clinical application, these will doubtless be of great assistance.

The presence or absence of the malarial germ, of the Widal reaction, and the absence of any evidence of disease in other parts of the body are all worthy of consideration in so far as they are excluding or limiting factors in diagnosis.

The subjective symptoms of abdominal disease are pain, tenderness, nausea, anorexia, and general malaise. The character of the pain is sometimes quite significant, and its paroxysmal quality can occasionally be recognized as due to the visible peristaltic motion of the abdominal viscera. The tenderness is not always coextensive with the area of reflected pain. In appendicitis it is usually most prominent over the appendix; in disease of the gall-bladder, over this organ; in ulcer of the stomach it is sometimes limited to a very small area; in disease of the kidneys and ureters, it can sometimes be definitely limited to these organs, though it is usually accompanied by more or less general abdominal tenderness. The nausea is often an early symptom, not uncommonly a persistent one, and it appears in connection with disease of almost every abdominal organ.

After long surgical and pathologic study and experience, the abdomen comes to appear to the diag-

nostician as it were a transparent, or semi-transparent, anatomic and pathologic manikin, in which certain points stand out brilliantly luminous. First of all, the appendix appears as a comet-like luminosity, the head of which is in the right iliac region, with the many-rayed tail advancing over every part of the abdomen in which the symptoms of disease of the appendix show themselves by pain or by other clinical signs. The right rectus abdominis glows forth with diagnostic significance while the opposite side of the abdomen is inconspicuous and dark. At the pit of the stomach there is a nebulous luminosity which stands for the pain and nausea that usually initiate an attack of appendicular disease. (Plate I.)

Above this luminous spot of greatest brilliancy, as we approach the patient, we have a second spot which lies as a well-defined luminosity in the region of the gall-bladder, and has rays extending in all directions, but especially toward the tip of the right shoulder and backward toward the lower end of the right scapula. In those of middle and advanced life this luminosity is perhaps more prominent than that in the region of the appendix. As we look at it, waves of great brilliancy appear and are succeeded by intervals of darkness, representing the spasmodic character of the pain which often initiates an acute attack. (Plate II.)

In females after puberty two luminous spots appear on the right and left of the uterus in the pelvis, and in the minds of most of us these luminosities outshine all the others and stand for disease of the adnexa of the uterus.

In both males and females, in the adolescent and

in the adult, there are two less conspicuous luminosities, the centers of which are in the region of the kidneys, with rays extending downward to the vulva or the testicles and the knees. These stand for the diseases which are likely to appear in the kidneys and ureters. (Plate III.)

Thus, as we approach the abdomen for examination, the mind is concentrated upon the great probabilities of disease, and the examination is directed toward the exclusion of first one and then another hypothetical condition, until the right diagnosis is made and confirmed by the examination, the subjective symptoms, and the history of the case.

CHAPTER II

INTRODUCTION TO THE STUDY OF APPENDICITIS

Historic notes; definition; terminology; appendicitis an entity. The retention cyst. Anatomic considerations. Clinical considerations. Neglected appendicitis. The spread of infection.

No other clinical manifestation has derived so much from the vivisection examinations which modern laparotomies have afforded as the diseases of the appendix. Appendicitis was unrecognized by the ancients, as it is even now by many of our associates, except in the most advanced stages of the disease. It was usually termed inflammation of the bowels, perityphlitis or perityphlitic abscess; but the importance of the appendix as the atrium of the disease was rarely suspected. One of the earliest and most complete accounts of the pathology of perityphlitis through perforation of the appendix was made by Grissole in 1839. This was not, however, an exceptional observation, for other authors noted perforation and ulceration of the appendix in the midst of perityphlitis, but failed to recognize the significance of the combination.

The chapter on appendicitis is distinctly an American contribution to surgery, and it is one in which the borderland of surgery has been pushed forward into the domain of medicine. With Willard Parker's contribution in 1867, the real study of this disease began.

It reached a culmination in the New York State Medical Society in 1891, when McBurney read his paper containing the report of 24 early operations, with 23 recoveries and 1 death. There have been great fluctuations in the opinion of the profession with regard to this disease and its surgical treatment, and each fluctuation brings opinion nearer and nearer to an equilibrium. Every phase of intellect and every fad of therapeutics has contributed toward this end. Many monographs have been written, either to express personal opinion or prejudice or to connote the results of bibliographic research.

Appendicitis is a term applied to inflammatory conditions within the appendix, and to that symptom-complex which results from the progress of the disease. The various manifestations of appendicitis are frequently limited by adjectives more or less descriptive and significant. Catarrhal appendicitis refers to that condition in which the mucous membrane is undestroyed. Suppurative appendicitis applies to cases in which the mucous membrane is destroyed and the wall of the appendix is invaded by microörganisms, producing pus. In cases of appendicitis in which the lumen of the appendix is destroyed and the appendix becomes a solid mass the term obliterating appendicitis has been applied. When the pathologic process passes outside the appendix, it gives rise to a periappendicitis or a perityphlitis, and when it is intended to call particular attention to the inflammation of the peritoneum it is called a periappendicular peritonitis. When an abscess forms about the appendix, it is termed a periappendicular abscess. In this manner terms are

multiplied, which are extremely confusing, and bear no relation whatever to the pathology of the disease, except as descriptive or limiting adjectives. The character of the infecting microörganism sometimes determines the distinctive appellation of the appendicitis. Thus, when the primary infection is the tubercle bacillus, the disease has been termed a tuberculous appendicitis; when the actinomycotic fungus, appendicular actinomycosis.

The names that have been applied to the various forms of appendicitis, whether derived from the examination of the removed appendix or suggested by the clinical manifestations of the disease, are error-breeding and misleading. Outside of a disease of the appendix due to actinomycosis, to tuberculosis, or to carcinoma, appendicitis is an entity, with very many possible manifestations, rather than several well-defined conditions or independent diseases.

THE RETENTION CYST

The basic problem stated. Mechanism of the disease. Clinical picture of sudden stenosis of the valve of Gerlach; of gradual stenosis.

It is probable that in the beginning every case of appendicitis is a simple retention cyst. The cystic content is derived from the secretions of the appendix, and in this medium the colon bacillus and other more or less accidental microörganisms find suitable conditions for growth. The obstructing element is the too obtrusive or the deformed valve of Gerlach. The toxines produced by the growth of the bacteria within

the appendix cause violent contractions in its muscular wall. These contractions are at first effective in opening up the partial stenosis at the valve into the cecum. Through these contractions the appendix becomes more or less hypertrophied and strengthened, and during the course of the paroxysm the patient at last becomes aware of abdominal pain. These periods of activity vary greatly in intensity, and may be separated by intervals of hours, weeks, or even years. The mucous membrane of the appendix remains practically unchanged; the vascular and lymph systems are only slightly increased in extent and activity; the muscular and nervous elements undergo hypertrophy, and become on the one hand more powerful, and on the other hand more sensitive to pain.

In the progress of the disease the time comes when the stenosis is complete, or almost complete, and the manifestations of lesion depend upon the acuteness or rapidity of this closure. When the stenosis is sudden the whole appendix is distended, but to no great size, and the anemic condition of the mucosa results in ulcerations and defects opening up the lymph spaces to direct contact with the infection. These lymph spaces are invaded by the pathogenic organism, and surrounded by active leucocytes. The lymph channels of the mesentery of the appendix, and the lymph glands in the appendix and its mesentery, are engorged, enlarged, and sometimes infected, Fig. 2. At this time the patient shows the symptoms of infection; the temperature rises; the pulse is accelerated; there is pain in proportion to the activity of the muscular contractions and the extent of the irritation of

the periappendicular peritoneum. The vigorous muscular contractions extend into the small intestine, and peritoneal shock adds to the nausea, and even provokes vomiting. The early pains, the distress, the faint feelings, are referred to the pit of the stomach.

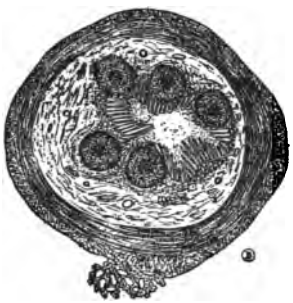


Fig. 2. Cross-section of the appendix of Mr. W., a case of recurring appendicitis one week after an exacerbation, showing defects in the mucosa, invasion of the submucosa with active leucocytes, marked lymphadenitis of the intra-appendicular lymph tissues, and general vascularization of the submucosa and mesentery. The vascularization of the peritoneum, subperitoneal tissues, and muscle tunics had disappeared. (Drawn by J. D. Blything.)

If the patient is palpated at this time, besides the rigidity of the right rectus muscle there is a general abdominal tenderness, and a very pronounced area of pain directly over the appendix, accompanied by a feeling of faintness and nausea on prolonged pressure. The bowels are usually constipated, though there has often been a preceding diarrhea. As soon as the peritonitis becomes at all marked there is colicky pain and considerable tympany, and on palpation there is heard a gurgling sound much more pronounced in the region of the appendix than elsewhere. An examination of the blood shows a hyperleucocytosis, usually reaching as many as 15,000 to 20,000 to the cmm.

When the obstruction progresses slowly in an appendix in which the muscularis remains elastic, the organ may attain to a very great size, and exhibit a marked degree of distention. Its wall will be found in one of two very distinct conditions. In some

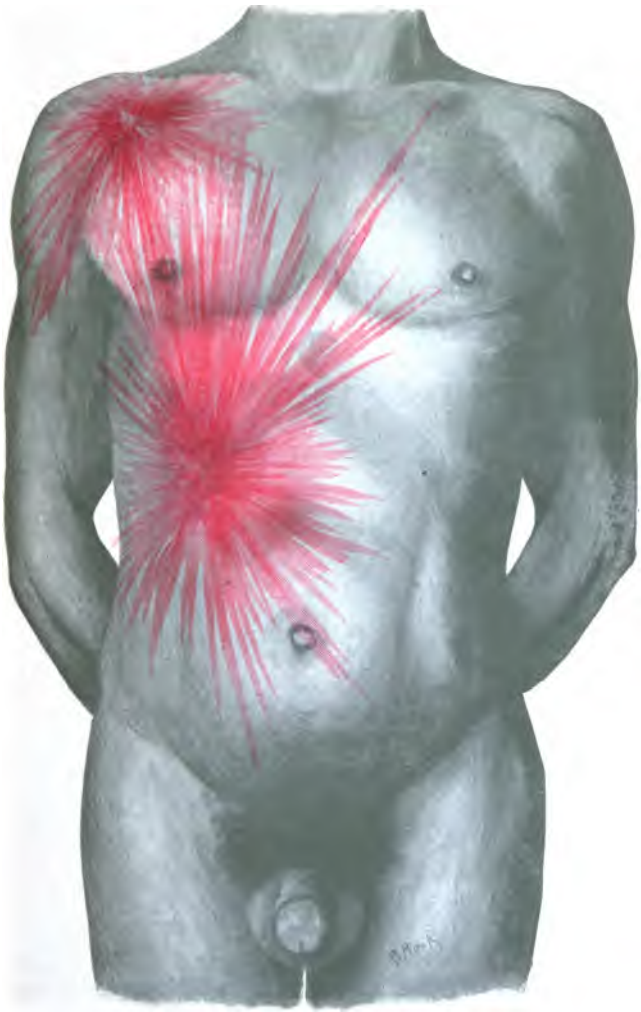


PLATE II

Ideal manikin, with the luminosities calling attention to diseases of the biliary apparatus.

cases, after a symptomless but protracted retention cyst of the appendix, the evidences of ulceration of the mucosa and infection show themselves, and if promptly operated upon, the appendix is found squash-shaped and with a muscular wall three-eighths of an inch thick. The evidences of peritonitis, lymphangitis, and lymphadenitis—namely, the tympanites, the pain, the tenderness, the vomiting, and the leucocytosis — are similar to those observed in acute obstruction. The pain is probably more violent on account of the hypertrophy of the muscles, and the abnormal increase of function in the nerve supply. The peritonitis, too, is usually more extensive. In other cases, in which the partial obstruction is very prolonged and follows an acute inflammation which has left a large amount of connective tissue in the wall of the appendix, thus limiting the power of the muscular apparatus, the appendix remains only slightly dilated, and its wall, especially the mucous coat, abnormally thinned, Fig. 3. If the obstruction is complete, and the amount of mucus sufficient, the unyielding and parchment-like appendix either ruptures into the general peritoneal cavity or becomes wholly necrotic. It is comparable to the white gall-bladder, and its distention results in the same catastrophe.

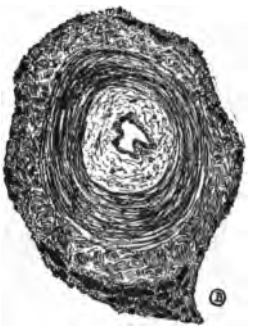


Fig. 3. Cross-section of a chronically inflamed appendix, with almost complete obliteration of the intraappendicular lymphatics, great atrophy of the mucosa, sclerotic infiltration of the muscular tunics and hypertrophy and vascularization of the peritoneum and subperitoneal tissues, with marked vascularization of the mesentery. (Drawn by J. D. Blything.)

ANATOMIC CONSIDERATIONS

Fetal anatomy of the appendix. Histology of the appendix. Surgical anatomy of the appendix.

In the fetus the cecum is an elongated, fusiform diverticulum, and at birth it is a long, coiled portion of the gut, tapering to a point, from which begin the three teniæ coli. Very early, however, one or more of these earliest haustra, or dilatations, become enormously distended, and the original fusiform fundus becomes small, contracted, and rudimentary, so that it appears in the adult as a mere appendix to these dilated basal haustra to which the name cecum is limited. The terminal part of the primitive cecum never dilates, and is known as the vermiform appendix.

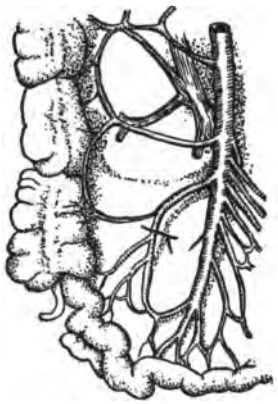


Fig. 4. Schematic drawing showing the blood supply of the cecum and adjoining portion of the ileum and the appendix, from the first branches of the superior mesenteric artery. It will be noticed that this region is supplied by the accessory arteries which arose after the excursion of the cecum brought the end of the large intestine into the right iliac region.

The vermiform appendix is a portion of the cecum which is normally attached to the abdominal wall by a mesentery, the so-called mesenteriolum. It is ordinarily 6 to 10 cm. long, and less than 1 cm. in diameter, but it is quite variable in length and size. It is covered by a peritoneum which is continuous with the peritoneum of its mesentery and

the abdominal wall. It has a longitudinal and circular muscular coat, and its mucous membrane is thick, and rich in lymph follicles. The blood supply of the appendix comes through its mesentery by one or two arteries, which sometimes attain to a considerable size. They have the same origin as the arteries of the cecum and ascending colon, the superior mesenteric artery, Fig. 4. The veins of the appendix, forming a rich network in the peritoneal covering, empty through three or four large veins in the mesentery into the portal system, and communicate in the female with the veins of the ovary. The lymph vessels from the appendix pass through one or two series of lymph glands in its mesentery, and unite with the lymph channels from the colon, Figs. 5 and 6. The innervation of the appendix has been traced to the mesenteric plexus of the sympathetic. The peritoneum of the appendix is insensible to pain when in an uninflamed condition, but

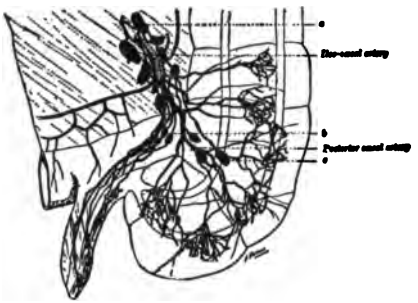


Fig. 5. Dorsal view of ileocecal region, showing the course of the lymphatics and the lymphatic glands. (After Poirier and Cunéo.)

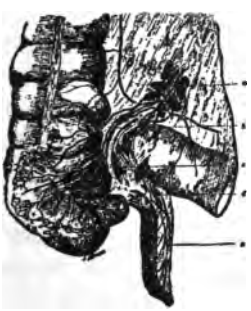


Fig 6. Ventral view of ileocecal region, showing the course of the lymphatics. (After Poirier and Cunéo.)

with increased vascularity it becomes extremely sensitive, though the subjective location of the pain is referred to the upper portion of the abdomen. It has been observed, for example, that crushing the base of the appendix causes pain at the umbilicus. The blood-vessels and the lymph apparatus of the appendix are small and inconspicuous when the organ is quiescent, but when it is in the process of chronic or acute inflammation the arteries are so large that a fatal hemorrhage may result from failure to completely ligate them, and the veins are of such size that an infected advancing thrombus quickly obliterates the mesenteric veins, to which they are tributary, and produces an irremediable thrombosis. The lymph glands themselves sometimes attain to a considerable size between the two folds of peritoneum in the mesentery of the appendix, and even break down and result in abscess. The mucous membrane of the appendix at its entrance into the cecum makes a fold or valve, which was described by Gerlach, and which is doubtless the seat of lesion in acute obstructive appendicitis.

Histologically considered the appendix presents, as also in its gross anatomy, a close similarity of structure to the large intestine, the natural result of its developmental relationship to the organ of which it is an integral part. Like the intestine it possesses a covering of peritoneum, it is swung in its proper mesentery, and passing from without towards the lumen of the organ, one finds in their normal order of succession the longitudinal and circular tunics of

muscle fibers, a layer of submucous tissue, with its muscularis mucosæ, and finally the epithelium with its lymphoid follicles, and its crypts of Lieberkühn, exhibiting columnar and goblet cells in every way comparable to those of the large gut, Fig. 7.

There are, however, notable differences in the structure of the appendix as compared with that of the general intestine, and in their consideration together the student may perhaps be led to a completer understanding of the points of similarity, as well as those of contrast, than by any other method. The longitudinal muscle fibers of the appendix effect a complete and even investiture of the tube, and are not, as in the case of the remainder of the large gut, gathered into three separate muscular bands. Owing to this feature the appendix lacks that sacculated appearance which is, with the exception of the rectum, so characteristic of the large intestine. It is doubtless of profit to the individual that such sacculation does not exist in the appendix, for it may easily be conceived how such pouches, representing as they do places of lesser resistance in the intestinal wall, would offer not only an immense impediment to the ordinary expulsion of the appendiceal contents into the cecum, but also in cases of appendicitis, with or

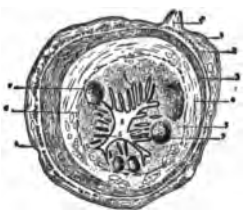


Fig. 7. The histologic structure of the appendix. (From Testut.) 1, peritoneal covering; 1′, mesenteric attachment; 2, layer of longitudinal muscular fibres; 3, layer of circular fibres; 4, submucosa; 5, mucous membrane; 5′, muscularis mucosæ; 6, glands of Lieberkühn; 7-7, closed follicles; 8, cavity of the appendix.

without obstruction at the valve of Gerlach, facilitate retention of inflammatory products and add to the danger of perforation.

It is in the mucosa and submucosa of the appendix that the more important structural deviations are found. The crypts of the mucosa, most abundant in the lower third of the tube, are not so deep as elsewhere in the intestinal tract, nor are the spaces between them so wide. The relative proportion of goblet cells to those of the simple columnar type is very great.

The most remarkable, and from a pathologic standpoint the most important, elements of the appendix are the lymphoid nodules. Individually these are not different from such structures elsewhere in the large intestine, presenting the same loose arrangement of lymphoid cells grouped about the more closely aggregated cells of the central portion. They are, however, relatively more numerous in the appendix than elsewhere. They are approximately spherical in form, being somewhat flattened in those aspects directed towards and away from the lumen of the appendix, and rarely exceed 1 mm. in diameter. They are properly elements of the submucous tissue, but encroach upon the mucous coat to such an extent that the intermediate glandular structures are much crowded together, while the epithelium overlying their exposed surfaces is reduced through pressure to a plate-like membrane of extreme tenuity. This crowded condition of the epithelial elements is easily comprehended in such a vestigial structure as is the appendix, and one which is constantly tending to

obliteration. We may assume that the atrophy of the muscular tunics of the organ has proceeded at a more rapid rate than in the case of the epithelial coat, thus causing the latter with its glands to occupy a space much smaller than was originally provided for its accommodation.

The dimensions of the lymphoid nodules are subject to constant variation not only as regards successive periods of life, but as well from day to day. In the infant they are round in outline, and vary from one-half to one mm. in diameter. These conditions obtain until about the thirtieth year of life, when a gradual shrinkage ensues, and in persons beyond mid-

Fig. 8. The appendix in the pelvic fossa.

Fig. 9. The appendix in the ileocolic fossa.

dle age they will have diminished to from one-fourth to one-eighth their former size. They are constantly taking rise from the stroma of the submucosa, attaining to a maximum size at the expense of the integrity of the overlying epithelium, and finally, having projected into the lumen of the tube, burst through the epithelial covering and discharge their contents into the lumen of the appendix. This culminating stage in the period of their activity is followed by a shrink-

age of the ruptured nodules, and a reorganization of the displaced and destroyed portions of epithelium above them.

The location of the appendix is a matter of vital surgical interest. It is necessary for the diagnostician to remember that the colon makes an excursion from the lower left iliac region upward and toward the right, and then downward into the right iliac region. This excursion is liable to be arrested at any point and leave the cecum and the appendix at any moment in its embryonal position. Thus, the appendix and colon are occasionally found entirely upon the left side of the abdomen. The appendix is then in the left hypochondrium. More frequently the excursion of the colon and cecum is carried over into the right hypochondrium, and the appendix is found somewhere between the liver and the crest of the ilium. These errors of development are rare, and yet they occur with unexpected frequency in patients requiring medical and surgical treatment.

Fig. 10. The appendix in the retrocecal fossa.

In the normal and properly developed person the location of the appendix is subject to great variation. Its displacement is due to variations from the normal evolutionary type, which can hardly be called errors of development, and to the results of injury and pathologic processes. In Plate V the mesenteries of

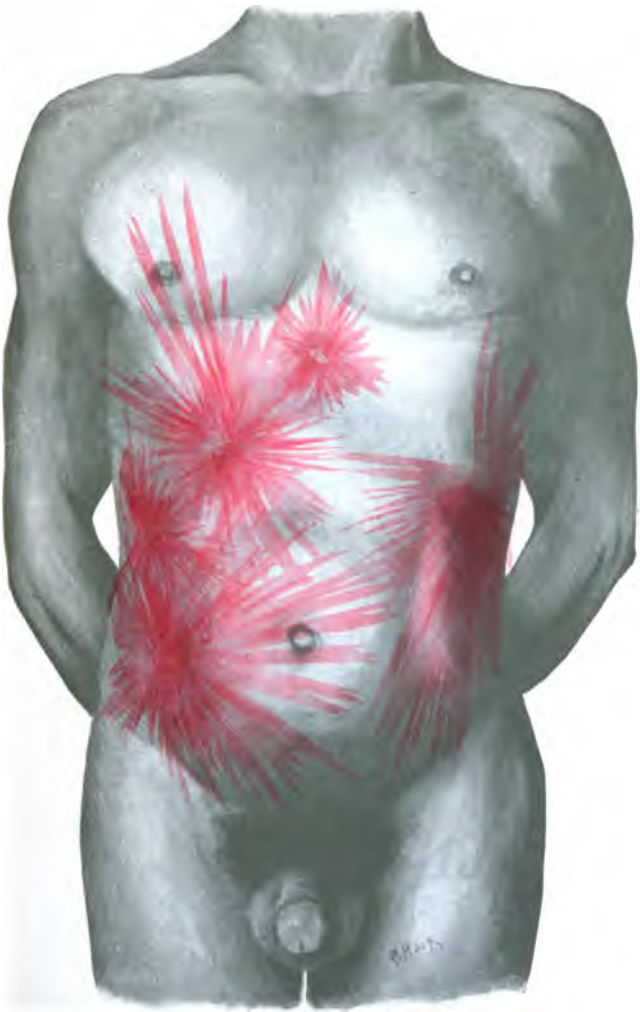
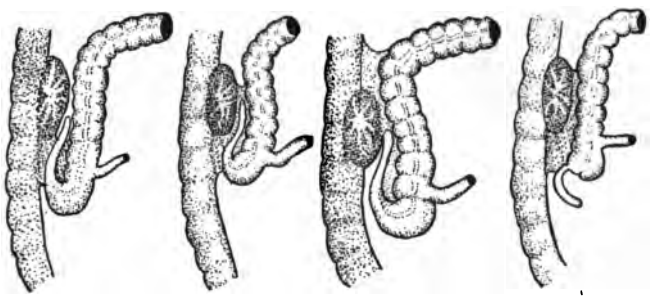


PLATE III

The ideal manikin, with the luminosities calling attention to diseases of the kidneys and ureters

the colon, the small intestine, and the other viscera are shown after the removal of these organs. Between the raw surfaces of these mesenteries are seen the great fossæ of the abdomen; the caudal portion is divided by three longitudinal mesenteries into four lakes, three of which open together in the pelvis. The appendix may be found in the pelvic fossa, and this



Figs. 11, 12, 13, 14. Four positions of the appendix in the retrocecal mesentery. After Huntington.

is the position in which we generally expect it. It hangs over the iliac vessels or floats in the pelvic contents, Figs. 8, 9. Less often it is found in the retrocecal fossa, Fig. 10. Here it is sometimes buried in the mesentery of the cecum and ascending colon by peritoneal adhesions of embryonal origin, see Figs. 11, 12, 13, 14. Rarest of all, and yet of great clinical importance is the location of the appendix in the ileocolic fossa, Fig. 15. In this instance, the appendix appears to hang over the ileum, or it is buried behind the cecum and ileum and in the course of inflammation it protrudes through the ileocecal mesen-

tery into the ileocolic fossa, Fig. 16. Occasionally the appendix remains ventrad to the cecum, Fig. 17, but this is a position of little clinical interest.

Besides these three most important and common locations it may be found in almost any part of the

Fig. 15. The appendix in the ileocolic fossa and over the ileum.

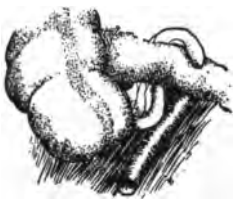


Fig. 16. The appendix behind the ileocecal valve.

abdomen, making a circle, the radii of which converge near the normal location of the cecum. Most of these abnormal positions are due to pathologic processes or to violent traumatism. Thus, the distal end of the appendix has been found attached to the gall-bladder, to the fundus of the stomach, to nearly every part of the transverse and descending colon, to the sigmoid flexure, to the rectum in the retrovesical pouch, to the urinary bladder, to the tubes, the ovaries, and the uterus, and to almost every part of the mesentery and small intestine.

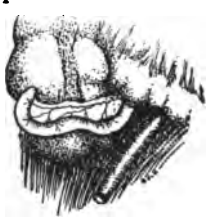


Fig. 17. The appendix hanging over the cecum.

The appendix is occasionally found in the hernial sac in inguinal and in femoral hernia, in the obturator and subperitoneal hernias of the pelvis. In these situations it frequently becomes firmly attached to the

most movable organs, such as the omentum, the small intestines, the ovaries, and after the reduction of the hernia it is carried with these movable organs to various parts of the abdomen.

CLINICAL CONSIDERATIONS

Etiology of appendicitis; the complete retention cyst; course of the disease; symptoms and clinical findings; illustrative case.

The etiology of appendicitis is clear enough in some particulars, but dark in others. The normal congenital constriction of the appendix at its mouth by the muscles of the cecum is a constant menace to health. This constriction is called the valve of Gerlach, and it is so arranged that it obstructs the entrance of fecal matter and intestinal contents into the appendix and readily allows the exit of the appendicular secretion into the cecum. But an unusual activity of the muscles of the cecum, or any injury of these muscles through external traumatism, or through the impaction and subsequent dislodgment of fecal matter in the cecum, may produce congestion, edema, and obstruction of the valve of Gerlach, with retention of the appendicular secretions, and therefore appendicitis. It happens also that the valve may be abnormally constructed and readily allow the passage of fecal matter into the appendix, and at the same time prevent its exit. Fecal bodies, concretions, and foreign bodies are found in the diseased appendix in something less than ten per cent of all cases. When there is obstruction or partial obstruction in the colon, the

cecum and appendix are frequently found greatly distended and filled with intestinal contents. A temporary obstruction of the colon might easily result in the same condition, and after the obstruction had passed away the appendix might be unable to dislodge the fecal matter. An abnormal position of the appendix in a hernial sac, or attached to some receding organ, has produced torsion or kinking at the valve of Gerlach and resulted in obstruction of this outlet and appendicitis. In a few instances pins, shingle-nails, capsules of medicine, seeds of fruit, gall-stones, and intestinal worms have been found in the diseased appendix.

Even over-distention of the appendix with its own contents frequently produces an obstruction through valve formation at its outlet, and this over-distention may be the result of coughing, jumping, straining at stool, vomiting, lifting, or even the progress of pregnancy. The importance of cough as a cause of appendicitis is generally overlooked. The relation between diarrhea, constipation, and indigestion on the one hand, and appendicitis on the other, is certainly very intimate, whether they are to be looked upon as causes or as results of the disease.

The accompanying drawing, Fig. 18, is a section through the valve of Gerlach showing the relation of the muscular elements of the colon and the appendix.

The production of the retention cyst is simple enough when the valve of Gerlach has become partially obstructed. It is a well-known principle that the complete obstruction of the duct of any gland results in its atrophy and disappearance, while the partial obstruction or intermittent obstruction of

the outlet of any gland results in hypertrophy of the secreting tissues. The only difference between the appendix and such a gland as the pancreas, a parotid or a lacteal gland lies in the fact that the duct or lumen of the appendix is large and always the home of the bacillus coli communis and other intestinal parasites or messmates. With the partial or interrupted obstruction of the valve of Gerlach, the secretions of the appendix increase greatly in quantity, and are probably modified in quality. Possibly they have a less active germicidal power. The muscular and lymphoid elements of the appendix become degenerated and atrophied. The secretions from the mucosa increase in quantity until some favorable moment when the valve of Gerlach becomes completely obstructed, then at once the growth of the bacteria within the lumen of the appendix produces a toxemia, the pressure results in anemia of some portion or portions of the mucosa, granular degeneration of the epithelium results, miliary hemorrhages occur in the submucosa, and even in the muscularis. The lymph apparatus gives way under the arterial pressure, the tissues are flooded with leucocytes, the serosa takes on an active regenerative process; it becomes vascular, and the picture of an acute or chronic appendicitis, Plate IV, is presented. The rapid increase in the

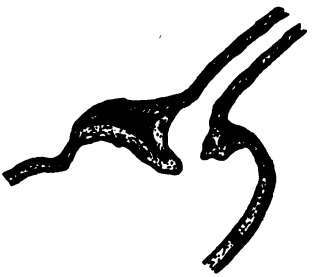


FIG. 18. The valve of Gerlach in an infant, one month old, dead of accidental disease.

size of the appendix is due not only to the increase in the amount of contained secretion, excretion, hemorrhage and pus formation, but also to the edematous condition and hypervascularization of the tissues of the appendix itself. The more acute the process, the greater the involvement of the muscularis, the submucosa, and the mucosa; the more chronic the process, the greater the involvement of the serosa; the more acute the process, the more elastic and distensible the walls of the appendix; the more chronic the process, the more inflexible, cartilaginous, and parchment-like the walls of the appendix; the more acute the process, the more likely is the valve of Gerlach to give way and allow the discharge of the pus, blood, and appendicular secretion into the cecum; the more chronic the process, the less likely is this event to occur; the more acute the process, the less likely are protective adhesions to form about the appendix; the more chronic the process, the more likely are these adhesions to be found. In the initial infection of the appendix the mesenteric lymph glands are rarely enlarged. In the late chronic inflammation of the appendix they may be so hypertrophied and so thoroughly infected that the removal of the appendix leaves the matrix of an abscess behind. It is uncertain whether thrombosis of the veins of the appendix and the mesenteric vein in the ileocecal mesentery, to which the veins of the appendix are tributary, is more likely to occur in the primary acute inflammation of the appendix or in an exacerbation in the chronic disease, but certain it is that an acute general diffuse peritonitis is more apt to follow the rupture of

a sclerosed appendix in an exacerbation of a chronic disease than it is to follow ever so acute an attack in its first manifestation.

The course of appendicitis is one of the most varied of all the infectious diseases. This is dependent upon the character of the infection, and more largely still upon the conditions which surround the appendix itself. A simple retention cyst of the appendix follows somewhat the following course: The obstruction to the outlet of the cyst is relative—it leaks—and with powerful muscular contractions the contents of the cyst are extruded into the gut. At first, because the nerve supply is probably wholly through the sympathetic, these muscular contractions are devoid of pain; but in the process of inflammation such changes occur in the nervous system as to result in a painful sensation on each and every violent muscular contraction in the wall of the appendix. This pain is felt at the pit of the stomach, and it is accompanied by an indistinct sensation of distress or nausea. In common language this condition is known as "belly-ache." It is momentarily distressing and disheartening to the patient. If the attack is in a child, he suddenly stops his play or occupation, leans forward, or throws himself upon the ground. As soon as the contraction has passed off, the distress and pain disappear, and the child jumps up and continues his game. These violent contractions of the appendix are initiated by contractions in the surrounding gut, due either to efforts at stool, or to the appearance of food in the stomach.

If the obstruction at the mouth of the appendix becomes at any time complete, the resulting pain is

intolerable, and the mucous membrane of the appendix becomes anemic, infected, and at last necrotic, thus producing an ulcer. Fig. 19. Through this ulcer the muscles of the appendix become intoxicated and powerless, all efforts at contraction cease, the parox-

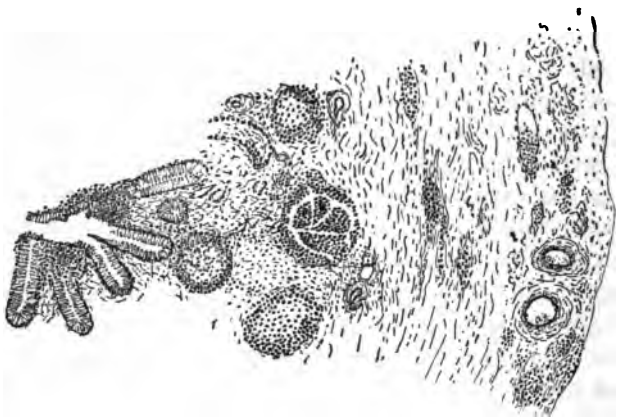


FIG. 19. Segment of an appendix in a moderately acute attack. At the left the mucosa is considerably broken up and infiltrated. It still maintains its normal folded arrangement to a remarkable degree. Four lymph nodes are highly inflamed, and one of them almost broken down. The muscle is infiltrated with leucocytes in various places. Even the serosa is highly vascular, and in places infiltrated with active cells. (Drawn with camera lucida from appendix of Mr. W.)

ysms disappear; the lymph tissues of the appendix are filled with infection. The appearance of the ulcer is sometimes announced by a pronounced chill, and a subsequent general infection can be measured by the rise of temperature and the rapidly increasing leucocytosis. The next step in the course of the disease is the intoxication, the reaction, and the hyperemia of the peritoneal coverings of the appendix and its mesentery. The blood-vessels in the peritoneum

PLATE IV

This highly magnified, colored drawing shows the changes occurring in the tissues of the vermiform appendix in 1, chronic inflammation, and 2, acute inflammation. The section shown on the right, 2, is from an acutely inflamed appendix, and is stained with eosin and hemotoxylin, while that on the left, 1, is from a chronically inflamed appendix, and is stained by the Van Gieson method. Nearly all the changes that occur in an acute inflammation may where can be seen in the picture on the right, 2. The entire wall of the appendix is swollen; pus and blood are found in the lumen; the epithelium lined from the mucosa by the serous exudate, and many individual epithelial cells show mucoid degeneration. An extensive exudate of plasma, leucocytes and red cells swell the mucosa and submucosa. The muscularis mucosæ is shown in the picture, but was broken up in many parts of the section. An enlarged lymph follicle is seen in the upper part of the submucosa. This round cell infiltration and exudation of plasma in the muscular layers has caused a marked splitting of the muscle fibers, which is seen best in the circular layer. The serosa is also edematous, and dilated blood-vessels are found in it.

The wall of the chronically inflamed appendix 1, shows some thickening. The muscularis mucosæ has largely disappeared. Throughout the mucosa and submucosa can be seen an excessive amount of fibrous tissue, indicated by the red color of the Van Gieson stain. Many newly formed blood-vessels are present, and many small lymph follicles, which have been squeezed down by the surrounding tissue. The muscular coats are much changed. Many of the smooth muscle nuclei have disappeared, and fibrous deposits occur between the muscle fibers. This degeneration and contraction results in a fragile condition of the wall of the appendix, favoring rupture. The serosa is much thickened by the newly formed vessels and fibrous tissue. (Drawn by Dr. Charles G. Davies, in the laboratory of Dr. Ludwig Hektoen.)

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become enormously enlarged so that they actually stand up on the surface of the appendix; a stream of lymph is poured out from the peritoneal surface of the appendix into the general peritoneal cavity. This lymph contains intoxicated or actually infected leucocytes, and a similar intoxication appears in the peritoneum of the surrounding viscera and of the abdominal parietes. In the most pronounced cases there are several drams, or even several ounces, of a clear or slightly turbid fluid in the neighborhood of the appendix, and this fluid is found both in a sterile condition and in a condition of saturation with the colon bacillus, and even with other microörganisms. When the appendicular peritoneum becomes inflamed, the pain is localized in the region of the appendix, and the pain at the epigastrium either disappears or is overshadowed. This periappendicular pain radiates over the whole abdomen, and is more intense in proportion as the parietal peritoneum is involved. It is also more intense while the effusion about the appendix is slight, and when this effusion increases it spreads more over the whole abdomen, but becomes less intense over the appendix itself.

The symptoms in such a complete obstruction of an infected retention cyst of the appendix are very pronounced. They last for a period of only a few hours, when the symptoms of peritonitis come on and obscure those of appendicitis. There is usually an initial chill, and a rise of temperature to 104 or 105. The chill may be preceded, immediately followed, or even accompanied by vomiting, or at least by a very pronounced nausea. The chill is followed by anorexia,

sometimes by intermittent vomiting, and colicky pains, due to progress of the infection toward the peritoneum, and to movement of the appendix from the contraction of the surrounding viscera. The leucocytosis rises in the course of six or eight hours from 5,000 to 20,000 in the cmm. If at the time of the chill the leucocytes number 8,000, within two hours they frequently rise to 15,000, and in two hours more to 20,000 or 30,000. In the mean time the temperature falls and rests somewhere in the neighborhood of 102 or 103, with very great fluctuation within an hour or two. A very small number of leucocytes, 4,500 to 5,000, have been observed in conjunction with a suppurating cystic appendix.

In examining the patient's abdomen, the most common, uniform, and pronounced finding is the rigidity of the right rectus, and next to this comes the tenderness over the appendicular region. The patient usually lies fully extended in bed; he grows from hour to hour dusky and expressionless; the eye loses its luster, and the tongue becomes coated and thick; the patient has a listless and careless expression somewhat resembling that of seasickness.

The course of such an appendicitis is beautifully illustrated by the following case:

Mr. N., a student, twenty years old, had been to a theater on a Saturday night, and had eaten an oyster-house lunch before going home. He was not a drinker, and did not smoke. He was an athlete out of training, and a heretofore perfectly healthy and vigorous young man. He slept a little while, and then awoke and vomited, and in the morning on rising he found that he was nauseated, and that he had an indistinct distress at the pit of his stomach. After attempting to dress, he gave up, went back

to bed, and slept until nearly noon. On waking this second time he felt the abdominal distress, nausea, and a very excruciating pain at the pit of his stomach. His roommate recommended vomiting, and gave him several glasses of warm water to drink. He vomited profusely, and immediately had two or three movements of the bowels. These exertions caused excruciating pain. The pain continued after he went back to bed, and in the evening his roommate called Dr. J. E. Raycroft to see him. Dr. Raycroft found the temperature 102, the pulse relatively slow, and only a slight abdominal tenderness, which was most pronounced, however, over the pit of the stomach. He considered the case one of simple indigestion, but feared appendicitis, and gave him a Dover's powder; and denied all nourishment. During the night he slept at very short intervals, and was frequently awakened by colicky pains. Toward morning the pains became so intense that Dr. Raycroft was again called. He found a considerably distended abdomen, and a pronounced rigidity of the right rectus; the temperature was now 104, and the pulse about 100. The patient, who had ordinarily a most ruddy and animated countenance, appeared blank, dusky, and expressionless, like one badly intoxicated. There was distinct tenderness over the appendix, and the diagnosis of appendicitis was readily made. I was called in consultation, and I confirmed the above findings, and further demonstrated the fact that the general peritoneum was somewhat tender. The patient lay with the right leg slightly flexed, and his breathing was so rapid and his pulse so full and bounding that I examined carefully for pneumonia. In consultation with Dr. Raycroft, I looked upon the diagnosis of appendicitis as almost absolute, and finding no history of previous attacks, I believed that this one was probably produced by a completely obstructed valve of Gerlach and retention cyst. The danger of leaving the patient without operating seemed to me considerable, and the danger from an immediate operation seemed trifling. I suggested that there was every indication for the immediate removal of the appendix. I drew a square representing 100 cases, and made 5 of this 100 black to indicate that the chances of a serious termination of the case, either in abscess or in general peritonitis, was about five per cent. I then drew another square

representing 1,000 operations for conditions similar to this, and represented the chance of doing some damage by the operation as only one in a thousand, or one-tenth of one per cent. I placed these two squares side by side, and made the visual argument that with such a prognosis in any case, there was no doubt every indication for immediate operation.

The patient was at once removed to the Chicago Baptist Hospital, where the urinalysis and blood count showed that there was no nephritis, and that the leucocytosis was just beginning and had scarcely reached 20,000. There seemed no contraindication to an anesthetic and an operation. Chloroform was given, and in the presence of Dr. Joseph Flint and the house staff, and with the assistance of Dr. Raycroft, the abdomen was opened by a small incision on the outer side of the right rectus muscle. The appendix was quickly recognized with the index-finger, and brought into the wound. It was club-shaped, and distended to bursting. Fig. 20. The peritoneum of the appendix was edematous and highly vascular. The mesentery was ligated with fine silk, and the appendix cut away from it. The stump of the appendix was surrounded with a purse-string suture of fine silk, and the appendix cut away through its stenosed portion, close to the gut. The purse-string suture was then closed, and an extra layer of stitches covered the denuded portion of the peritoneum where the appendix had been cut away from the mesentery. A small amount of a clear serum was found in the peritoneal cavity, and removed. It was not examined for bacteria. The peritoneum was closed with catgut, the fasciæ and muscles brought together with larger and long-lasting catgut, the skin closed with silkworm gut, an antiseptic dressing applied, and the patient put to bed.

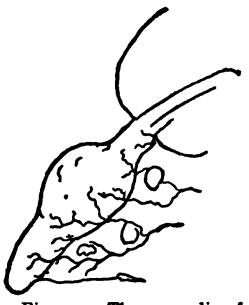

Fig. 20. The appendix of Mr. N.

The appendix was examined as soon as removed. It was about four inches long and three-quarters of an inch in diameter in its widest place. When it was cut open, it was found to con-

tain pus and a small amount of blood. The pus was full of colon bacilli, and many other micro-organisms of a saprophytic and putrefactive nature. The wall of the appendix had been much hypertrophied by the presence of a chronic retention cyst, so that the thickness of the wall was much greater than normal. The mucous membrane was flat and thin, and in one place it was ulcerated over an area one-quarter by one-half inch in extent. The lymph tissues of the appendix were greatly hypertrophied and infected, and in the mesentery itself there were several enlarged lymph glands. Had this obstruction persisted, and the case been let alone, there can be no doubt but that a few more hours' delay would have resulted in rupture.

On the following morning in making my rounds I found in the room in which this patient had been placed a young man whom I did not recognize, and with a most beautiful and animated expression. I addressed him, and apologized for having broken in upon his privacy, and was about to withdraw when he asked me a question which discovered the fact that he was the patient I had operated on the day before. The change in his appearance was so great in this short time that I had failed to recognize him. The temperature had fallen immediately after the operation, and his subsequent recovery was uneventful and otherwise uninteresting.

NEGLECTED APPENDICITIS

Possible terminations under the expectant treatment; illustrative cases; sequelæ in neglected cases.

In a general way there are two distinct clinical courses which a neglected case of appendicitis may follow when it is attended by an acute absolute obstruction at the valve of Gerlach. In the first instance the infection of the peritoneum of the appendix may be slow; the walls of the appendix may be elastic; adhesions may form covering in the appendix or the periappendicular effusion, and a perityphlitic abscess,

with thick, firm walls may result. This is without doubt the most favorable course that an appendicitis can be expected to follow. In the second place, the ulcer of the mucosa within the appendix may extend into the muscularis and result in a perforation of the serosa, or the walls of the appendix may be inelastic, sclerotic, and brittle, and the appendix may actually rupture, or the infection may produce a thrombosis in the greatly enlarged blood-vessels that are always found in the submucous tissues in chronic appendicitis, and complete gangrene of the muscularis and serosa may result, thus producing a sudden infection of the general peritoneal cavity, a diffuse peritonitis, or a general septic peritonitis. In such an instance the peritoneal cavity becomes suddenly filled with a large quantity of pus which is rapidly disseminated by the peristaltic movements of the intestine into distant parts of the peritoneal cavity. The patient is profoundly intoxicated, and if he survive a few hours, the symptoms of nephritis, hepatitis, and inflammation of other parenchymatous organs come on, and present conditions so serious that the peritonitis itself seems almost secondary in importance.

The former of these manifestations is fortunately the more common and infinitely more favorable. The latter is almost hopeless and relatively rare. But no one is able to predict in any particular instance which of these two courses will eventuate. Perhaps no better way of getting a picture of these manifestations can be suggested than by recounting illustrative cases, two of the former condition, and one of the latter. To illustrate the former condition when so discovered

as to permit opening the abscess and appendicectomy, consider the following case:

Mr. M., a Scandinavian mail-collector, 52 years old, had a good family and personal history. He weighed about 185 pounds, and was nearly six feet tall. He had never been troubled with dyspepsia nor any abdominal disturbance which would suggest a chronic appendicitis. He had been a mail-collector for ten years, and had previously had a steady outdoor occupation. The only matter of history contributory to this attack was the fact that he jumped up and down from his mail cart many times a day in collecting mail from the boxes.

While visiting in Indiana in June, 1900, he had a violent attack typical of an acute appendicitis. There was belly ache, protracted vomiting, great abdominal distress, and at last great abdominal pain and tenderness. The tenderness was in the region of the appendix. He was treated by starvation and large doses of morphine. At the end of two weeks he was sufficiently recovered to return home. He lay in bed with great abdominal pain for a week, and then called a physician. At this time the temperature was 99 and the pulse slow, and but for a tender mass in the abdomen a diagnosis of typhoid fever might readily have been made. This mass was about the size of a fist, and so hard and nodular that it gave the impression, in a man so old as this patient, of a carcinoma firmly attached to the posterior abdominal wall. It was tender, hard, nodular, irregular in form, and the intestines covered it completely so that it was overlaid by a tympanitic area. It occupied a position midway between the liver and the crest of the ilium, close against the spine. The patient was brought to the Baptist Hospital, where all the symptoms of infection were found in the urine and blood. The temperature range was slight, varying between 97 and 100, and the pulse slow, between 70 and 90. There was anorexia, a typhoid-appearing tongue, and a considerable hebetude. The Widal test was made several times, with negative result, and at last, with a diagnosis of a chronic periappendicular abscess, the abdomen was opened. The first impression on palpating through the abdominal incision was that of a carcinoma.

The intestines were protected by large abdominal sponges, and the cecum traced downward into the tumor. The adhesions were broken up with a dissecting forceps and the finger. The appendix was found in the ileocolic fossa, surrounded by a mass of thickened peritoneum, and by a lake of foul-smelling pus. It was carefully enucleated with the finger and dissecting forceps, and after crushing its attachment to the cecum it was torn away. The wound was sponged out, and the cavity packed with gauze, which was brought out through the abdominal wound. The protecting sponges were then removed, and the large incision partially closed. The patient made an uneventful recovery without fistula.

One is not always so fortunate as to find the appendix in the midst of a periappendicular abscess. When the abscess is opened the most careful search may fail to discover the location of the appendix, and the well-grounded fear which the surgeon has of breaking up the adhesions between intestines and exposing the general peritoneum to infection calls for great caution in prosecuting this search. The method of treatment under such circumstances is illustrated by the case of an Italian boy brought to me from the Brainard Polyclinic by Dr. Bradley:

The patient was 21 years old, and had just arrived in America from southern Italy, and was unable to speak English. He had been sick for several days, but the history of the case was only imperfectly secured by Dr. Bradley. The right iliac region presented a tumor the size of a fist. The patient's temperature was high and his pulse only relatively rapid. He had almarked leucocytosis, and great tenderness over the tumor. The tympanites was small, and there was no obstruction of the bowels at the time of operation. The patient was brought to the hospital immediately after his first examination by Dr. Bradley, and was operated upon January 31, 1904, at ten o'clock at night. As soon as the abdominal wall was opened by a longitudinal incision one inch and a half long on

the outer border of the rectus the marked edema of all of the tissues of the abdominal wall was perfectly evident. The tumor was firmly attached to the parietal peritoneum, and was opened with great care by the use of a dull dissecting forceps. About six ounces of pus with a fetid and fecal smell came out. The interior of the abscess cavity was carefully sponged out, and the appendix sought with the tip of the index-finger. After very careful search, and after repeated sponging of the cavity, no trace of the appendix could be made out in the thick and cartilaginous wall of the abscess. The cavity was then packed with a long strip of iodoform gauze, left hanging out of the wound, and the search abandoned. After this operation the patient's condition greatly improved, and the gauze was entirely removed by the end of three weeks. Fearing the escape of the patient with the appendix still left behind, he was anesthetized again on February 22d, about three weeks after the first operation, and the appendix sought for without waiting for the complete closure of the wound. The suppurating sinus was carefully excised as far as the bottom of the abdominal wall by means of an incision in the old scar which separated the sinus from the clean muscle. The general peritoneal cavity was then opened, and scarcely any remnant of the thick and cartilaginous walls of the abscess could be found. The appendix presented itself at once to the examining index-finger, and was easily brought into the wound and removed in the usual manner. It was surrounded in several places by a tortuous suppurating sinus, connected with the sinus excised from the abdominal wound. The complete disappearance of the thickened walls of the old abscess was most striking, especially to the minds of my assistants who had palpated the original abscess, and now felt the almost normal condition of the ileocecal region. On account of the infection and the absence of peritoneum over the cecum, the wound was closed with a small iodoform tamponade laid in contact with all the denuded surfaces. The larger portion of the wound was closed with buried catgut peritoneal and muscular stitches and superficial silkworm gut stitches. The patient could not be kept in bed, and went around the wards after the second day. The tampon was all removed by the end of a week, and an emphysema was noticed over the

whole right side of the abdomen as high up as the nipple on the right chest, which was probably due to the escape of air into the intermuscular space about the wound and its being pumped forward by the muscular activity in rising and walking. This emphysema disappeared without event after a few days.

Cases like these are relative.y common, but unfortunately they do not all terminate so favorably. In any case the abscess is found in the pelvis, in the ileocecal fossa, in the retrocecal fossa, in the ileocolic fossa, or in two or more of these locations. In many instances it is impossible, on account of the thickening of the serosa of the abdominal wall, the intestine, and the mesentery, to decide where the abscess originated. Two quite remote abscesses are frequently present. After the abscess has existed for a long time the most delicate structures, such as the peritoneum of the mesentery, the tissues of the omentum, and mesocolon, and abdominal wall, become hypertrophied and infiltrated until they resemble cartilaginous masses the thickness of the hand. The appendix is often torn away from the inflamed mesentery by the finger-nail. The hemorrhage is usually slight, but may be so severe as to necessitate tamponade. Success in the treatment of such cases depends upon the removal of the pus without infecting the general peritoneal cavity, and eventually the complete removal of all of the mucous membrane of the appendix. This is the condition that is sought for by those who treat acute appendicitis by the starvation, gastric lavage, and nutrient enema method.

When the retention cyst ulcerates rapidly with ensuing rupture of its wall, it discharges its contents

suddenly into the general peritoneal cavity, and the shock and pain are terrible to behold. The course of such a case is illustrated by the mournful instance of one of my neighbors.

A. B. was a medical student, 23 years of age. He was an athlete of some distinction, and a well put up young man of perfect health and habits. Sunday night of June, 1901, he awoke with a sharp abdominal pain; he felt that this pain might have been due to a late lunch. He tossed about for an hour or two and then vomited, and was surprised that the vomited matter contained no evidence of his lunch. The next morning his father looked him over, and fearing appendicitis, called in another physician. The diagnosis of appendicitis was made by them, and the young man was treated with enemas and absolute starvation, a method of maltreatment which had just then been exploited through the medical press. On Tuesday he was quite sick; his temperature was 102.3, and he had abdominal pains, with headache, backache, and pains in the legs. Wednesday he suffered so much pain that considerable doses of morphine were given, and though his temperature was slightly higher, his pulse was slow and full, and of good quality. Wednesday afternoon he had a most agonizing pain, felt terribly faint and sick, and fell into a perspiration which wet the bed. His temperature went down to normal, and his pulse was about 130. During Wednesday afternoon he had painful urination, and the urine was found to contain some albumin. Wednesday night was a very uncomfortable night for him, and he appeared extremely sick, though he had no very severe pain. I saw him at six o'clock Thursday morning. When I came into his room I recognized the Hippocratic expression of the face. It was ominous and terrible to behold. His pulse was rapid, 120; his temperature was 99; the abdominal muscles were all rigid; his hips and knees were flexed, and he lay immovable in bed. The whole abdomen was excessively tender on pressure, and a rectal examination discovered great tenderness and apparent tumor high up behind the bladder; but this examination was extremely unsatisfactory. A diagnosis of a ruptured appendix was made from the history and the findings, and the patient

was taken at once to the Chicago Baptist Hospital. The examination of the urine removed from the bladder showed a most extensive, acute nephritis. It was loaded with albumin and casts. The examination of the blood showed a high grade of leucocytosis. The father was told that the conditions were most serious ; that the general peritonitis had resulted in so high a grade of toxemia as to produce a nephritis of the most aggravated type. He was assured of the fact that a general peritonitis is absolutely fatal, and that even a limited peritonitis with so virulent an intoxication could hardly be expected to recover even with adequate drainage. Nevertheless he was assured that from the standpoint of the surgeon duty required that the extensive peritoneal abscess be immediately drained, and drained as completely as possible.

The patient was anesthetized without any preliminary scrubbing and shaving. The abdomen was very quickly washed with soft soap and rapidly shaved. A three-inch incision was made on the outer border of the right rectus, and the peritoneal abscess immediately came into view. Without any effort to wash out the pus, the appendix was sought for and found, and carefully enucleated from its adherent peritoneum and removed. There was a defect in its wall half an inch from the distal end, and large enough to admit a lead pencil. There were some fecal concretions still left in the appendix. The intestines were covered with a gray, and in places yellowish, fibrin, which was so firmly adherent to the gut that when pulled off it left a bleeding surface. The hand was passed down into the pelvis, and a series of extensive abscesses were opened and discharged, and the cavities irrigated with normal salt solution. The greatest care was taken in this procedure to retain the intestines in the same position in which they were found. A second incision was then made upon the outer border of the left rectus. A large rubber drainage tube was passed through the primary incision downward behind the bladder and out through the second incision. The cavities which had been drained in the pelvis and lower abdomen were filled with long strips of gauze, some of them containing iodoform. The ends of this drainage tube were left outside the dressings, and each covered with a small dressing of its own. The operation lasted only half an hour.

The patient woke up from his anesthetic with a much better expression of countenance. The pulse came down, and the temperature went up considerably; the urine still remained loaded with casts and albumin, but a considerable quantity was passed. Every three hours a large enema of hot normal salt solution was given, and immediately following it the drainage tube was washed out with about two quarts of hot, normal salt solution. The vomiting ceased, the tympanites appeared less marked, and for eighteen hours there was considerable hope of recovery. Early the following morning the tympany became greater, vomiting began, and in spite of all attempts to dislodge the gas the vomiting became fecal, and the patient died thirty-six hours after the operation.

Only a partial postmortem examination was made. The abdomen was opened, and the anterior abdominal wall was found covered with yellowish gray lymph as high up as the umbilicus. The intestines in this neighborhood were only lightly attached to the abdominal wall, and they were streaked with similar lymph, which extended in streaks and in canals up to the attachment of the mesentery to the posterior abdominal wall. The pelvis contained the gauze and the drainage tube, and seemed perfectly well drained. There had been no hemhorrhage, and seemingly no extension of the disease on account of the operation. The peritoneal cavity was apparently open in all directions, with only slight adhesions between the intestines for short distances. There was nowhere any accumulation of pus or serum in the peritoneal cavity.

Attacks of appendicitis in which an ulcer in the mucous membrane has appeared are in themselves causes of subsequent attacks. Thus, if in one attack, due to whatever cause, an ulcer appears in the middle of the appendix, cessation of this attack is followed by the formation of a cicatricial contraction at the site of the old ulcer, which may produce a valve formation and initiate a second attack. Appendixes are frequently found showing a series of such constric-

tions. Such a case of partial appendicitis was that which I operated upon for Dr. Robert H. Babcock and Dr. Frank S. Churchill in March, 1903.

The patient was a woman of 26 years, who had suffered for four years of a mild neurasthenia. She had been engaged in a sedentary occupation with great financial care. On two or three occasions she had suffered severe attacks of abdominal pain, with nausea and distention of the abdomen. She was usually confined to bed for four or five days, but had never had a physician during an attack. The last preceding attack was at Christmas time, 1902. She was examined by Dr. Churchill on the morning of the day of the operation, and found to be suffering from severe pain at the pit of the stomach, with nausea. He found the region of the appendix excessively tender, and while conducting a thorough examination he emptied the colon and denied the patient all food. During the day the patient's pain increased, the abdomen became tympanitic, the temperature rose to 101 and the pulse to 100. In slightly anemic blood her leucocytes rose from 8,000 in the morning to 12,000 at ten o'clock at night, when I first saw her.

After going over the very careful studies of the case made by Dr. Babcock and Dr. Churchill, and after examining the patient, I determined that there was every evidence of chronic recurring appendicitis, without abscess formation, and at the present time there was an acute attack, which is always dangerous in the sclerosed and unyielding appendix. I therefore operated at once, and removed the perfectly free appendix, from which I made on the spot the accompanying sketch. Fig. 21. The mesentery of the appendix was filled with enlarged lymph glands, the evidence of long-continued disease. One-half the appendix was greatly enlarged, and covered with an edematous peritoneum in which the blood-vessels were enormously distended. The proximal half of the appendix was of normal size, color, and consistency, and on section showed no evidence of new or previous disease. At the junction of the normal with the diseased portion there was a distinct spiral fold of mucous membrane, somewhat resembling that in the cystic duct, which

was perfectly patent to a probe, but completely obstructive to the contained fluid.

The patient sat up on the day following the operation and every day afterwards. She left her room and discharged her nurse at the end of a week.

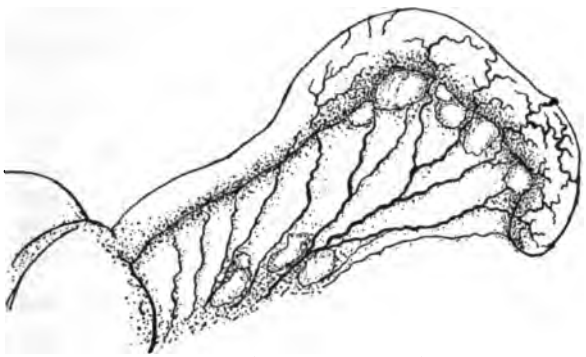

Fig. 21 A partial appendicitis.

Although the age of the patient can hardly be looked upon as an etiologic factor of much moment, it must be recognized that in the progress of development the appendix grows relatively smaller and smaller, while the cecum grows larger and larger; the attachment between the two becomes relatively more valve-like, due to the muscular contraction of the cecum in expelling its contents. Appendicitis, however, does appear in very young children, and probably on account of the relatively quiet habits of life and abstemious feeding, it is much less common in the very old than in middle life and adolescence.

It is probable that overdistention of the portal circulation is a predisposing cause of edema of the appendix, and thus of an appendicitis in males. This is

perhaps less imminent in females, in whom the venous circulation anastomoses with the genitourinary plexus of veins. In females an inflammation and edema of a tube or ovary probably assists in increasing the danger of appendicitis, and it is well recognized that disease of the right tube and of the appendix are remarkably common in the same individual.

THE SPREAD OF INFECTION

Peritoneal infection without rupture of the appendix; illustrative case. Periappendicular abscess; illustrative case. Gangrenous appendicitis; illustrative case.

In studying cases of appendicitis we are led to believe that the peritoneal cavity may be infected without absolute mechanical defect in the appendix itself. The appendix is distended with its own secretion, filled with the colon bacillus or other microörganisms, and as a result the lymph streams of the appendix are engorged with leucocytes containing bacteria. In great or less number these leucocytes are found all the way from the wall of the mucosa to the external wall of the appendix, the appendicular peritoneum. Fig. 19. They drop off into the peritoneal cavity, and at first while in small numbers the germicidal power of the healthy intestinal omental and parietal peritoneum is sufficient to destroy the infection. Later these adjoining peritoneal surfaces become excited, inflamed, and their germicidal power is brought to an end. This inflammation results in adhesions. Clinically these adhesions are termed protective adhesions, and the abscess is developed

between them and the appendix without any absolute perforation of the appendicular wall. The effusion of infected lymph is sometimes so rapid as to produce an actual lake of pus around the appendix, which would inevitably result in general peritonitis if left to itself. It is possible that this lake of pus may become surrounded with protective adhesions and the peritoneum in the neighborhood of the appendix may throw off the infection, and the appendix itself may discharge its contents into the colon and recover; then an abscess will be found at some distance from the appendix and lead the careless observer into error.

Thus we see that the appendix may remain intact, and a localized perityphlitic abscess may be formed around it; or, in the second place, the effusion through the intact wall of the appendix may be so rapid that a general peritonitis results, the appendix still remaining intact; and, in the third place, an abscess may appear far distant from the appendix, and before it is examined the appendicular peritoneum may recover and the appendix return to an uninflamed and normal condition.

As an illustration of the first of these cases, I will briefly recount the history of a cab-driver, who was brought into my clinic by Dr. Wuerth. On returning from his theater trip this cab-driver complained of severe abdominal pain, and vomited a lunch which he had eaten about one o'clock in the morning. The vomiting was preceded by pain and nausea, and was followed by a general tenderness of the abdomen. He suffered with colicky pains during the whole morning, and at seven o'clock called Dr. Wuerth. The doctor found him with a slightly elevated temperature, but a very slow and regular pulse. The man weighed 200 pounds, and palpation of the abdomen was very

unsatisfactory. The whole abdomen was apparently tender. There was only slight rigidity of the right rectus. A distinct point of tenderness was not recognizable. The colicky pains came on at intervals of a minute to a minute and a half, and lasted for half a minute, but there was always some abdominal pain. The point of greatest apparent pain as described by the patient was at the very pit of the stomach. The patient had previously suffered of a considerable diarrhea, and the bowels had moved a number of times during the night and early morning. On account of the slow pulse and the presence of diarrhea, Dr. Wuerth was uncertain of the diagnosis, though inclined to suspect a typhoid condition. He refrained from giving any morphine, advised the patient to remain quietly in bed, keep the stomach empty, and await further symptoms. At three o'clock a second examination was attempted. The patient now lay with the right leg flexed, was unwilling to rise or even turn over in bed, and complained bitterly of the colicky pain which he suffered and the general pain over the abdomen. His temperature still remained low — it was only 101 in the rectum — the pulse was slightly accelerated, 110, and his condition was such as to indicate intoxication. Dr. Wuerth believed the patient had distinct, acute appendicitis, without the history of a previous attack, and had him transferred at once to the Chicago Baptist Hospital. I examined him at four o'clock and confirmed all the previous findings. The urine was free from albumin and casts. I recommended an immediate operation for the removal of the appendix, which I believed must be a greatly distended retention cyst. As soon as the necessary preparations could be made, the abdomen shaved, and the patient bathed and properly dressed, he was anesthetized with chloroform, and on account of the great thickness of the abdominal wall a rather long incision was made, through which the appendix was approached. As soon as the peritoneum was opened, the lower right peritoneal cavity was found completely filled with a lake of creamy pus, in which the appendix was readily brought to view as a highly distended cyst about three inches long and nearly a half an inch in diameter, covered with an almost raw and generally vascular peritoneum. There was none of those

large veins and arteries to be seen which are so characteristic of the chronically inflamed appendix. The pus was washed away with a normal salt solution, poured from some height from a pitcher, and the space below and medially was packed with large laparotomy compresses. The appendix was removed in the usual manner. It was filled with a pus-like mucus containing many bacteria, but there was no evidence of any defect in its mucous, muscular, or peritoneal walls. I believed that the pus had not spread into the general peritoneal cavity, and therefore I refrained from washing out the whole peritoneum with normal salt solution. The region of the appendix was covered with strips of iodoform and plain gauze, which were packed in in such a manner as to form a large tampon draining each of the peritoneal watersheds. A very large amount of gauze was used in this tampon. The incision was only partially closed, and the patient was put to bed with a rather guarded prognosis. His recovery was very rapid and wholly uneventful. No albumin or casts ever appeared in his urine. He was starved for a week, at the end of which time the tampon had been little by little entirely removed and replaced by a very small iodoform gauze drain. The muscular contraction closed the abdominal wall completely without suture, and the skin was brought together by tying a few silkworm gut stitches that had been inserted at the time of the operation. At the end of three weeks he left the hospital, and he has remained perfectly well and strong, without any symptoms of adhesions, for the past two years.

This instance is typical of a small number of cases in which the effusion of pus in the neighborhood of the appendix is excessively rapid and is carried on without any macroscopic rupture or defect in the wall of the appendix. It is uncertain how frequent these cases are. They are unrecognized when not operated upon very early in their course, for while waiting the progress of the disease sufficient time elapses to permit of the destruction of the appendix, a condition

producing in its turn the most irremediable and terrible results.

It is not very unusual to find a periappendicular abscess surrounding an apparently perfectly normal appendix. When such an abscess is opened, it discharges its contents and recovers, leaving the appendix, while seemingly healthy, in such a condition as readily to give rise to subsequent attacks. It would be very easy from the experience of any surgeon to find cases in which such conditions have obtained. If distinct perforation exists between an appendix and a periappendicular abscess when the abscess is opened and drained, it fails to close, and a constant stream of infection passes from the interior of the appendix outward into the contracted abscess cavity, thus forming a sinus, and closure of this sinus can only be imagined when the defect in the wall of the appendix never existed or when the defect in the wall of the appendix has closed. That is to say, the obliteration of a periappendicular abscess by drainage is evidence that there is no defect in the wall of the appendix, because it could not possibly close if it were directly connected with the mucous membrane of the interior of the appendix.

One can never feel very safe in operating for appendicitis which has been in an acute stage for a number of days. He must always feel the lurking possibility of a distant focus of infection, a sort of gravity abscess at some distance from the appendix. It is probable that these uncertainties have led to the pernicious advice promulgated by some of our elders, and encouraged by the self-interest of the

operator, of waiting a week or ten days if the patient is not operated upon during the first twenty-four hours.

A case in my own practice illustrated this third form of distant abscess formation, without macroscopic defect in the wall of the appendix. Miss S., 24 years old, a teacher in the public schools, was taken violently sick in her school-room with abdominal pain and vomiting. She was obliged to remain in an anteroom for an hour or two, and was then taken home in a carriage, a distance of several blocks. On arriving home the pain disappeared, and she was able to take her supper at the usual time, and even go out in the evening. No physician saw her, and she looked upon the attack as one of a simple colic. She was able to attend lectures the following day, and went to church on Sunday. Sunday night she had a recurrence of the pain in a milder form, and this attack continued during the whole of Monday morning. My assistant saw her Monday noon, and reported a temperature of 103, and a very rapid pulse. She presented no symptoms other than the abdominal pain, the occasional vomiting, and the exquisite tenderness of the whole abdomen, and the rigidity of the abdominal muscles. A diagnosis of appendicitis was made, and I saw her in the evening. At this time the temperature had risen to 104; the pulse was 110 to 120; the vomiting had subsided, but the patient was in a state of profound intoxication. There were no attacks of colic, but the whole abdomen was tender, and the point of greatest tenderness could be easily made out as upon the right side and in the lower part of the abdomen. A vaginal examination disclosed no thickening of the pelvic tissues, and no evidence of any disease in the genitourinary apparatus. An antiseptic douche was given and a tampon of aseptic cotton applied to the cervix. She was wrapped up in a blanket and carried out of the house to an ambulance on a stretcher, and transported nearly ten miles to a hospital. In the light of subsequent developments this transportation seems to have been a very grave mistake. In the morning the tampon was examined and showed no evidence of gonococci; palpation of the abdomen and the temperature and pulse record still fur-

ther confirmed the diagnosis of appendicitis. The examination of the blood and urine, examination of the chest and the sinuses of the nose and ears, the examination of the throat and extremities, excluded almost positively any other disease. At ten o'clock, in the presence of Dr. Clark of Grinnell, Iowa, the appendix was approached by a very short incision; it was easily felt by the index-finger and brought out. It was very red and highly inflamed, with trifling adhesions to the adjoining viscera. The whole peritoneal surface of the appendix was red and raw looking, but there was no apparent defect in its wall anywhere. The mesentery was ligated with strong catgut, and the appendix removed through the completely obliterated valve of Gerlach, without any ligation or compression of the stump, so extensive and complete was this obliteration. The denuded surfaces were turned in and secured with fine silk sutures. The abdominal wound was completely closed. Following this operation the patient still maintained a temperature of 100 to 101, and her convalescence was rather slow. Her abdominal pains did not entirely subside until the end of ten days or two weeks, then she counted herself well, and was up and around the hospital. At the end of three weeks she went home, but she still complained of weakness, loss of appetite, and sweats. Her temperature kept up to 101, and sometimes 102 at night. She was visited by my assistant several times at her home. On one occasion, six or eight weeks after the operation, she had a violent attack of abdominal pain, and when my assistant visited her he found a temperature of 104. She was not able to go back to school. Three months after the operation she came to my office with her mother. She looked sick and miserable; her temperature was 100 at that time, and her pulse slightly above a hundred. She had not gained in weight, and she had little or no appetite; the tongue looked soft and thickened and coated. Her urine contained a small quantity of albumin and a considerable number of casts. The examination of the blood showed a very considerable anemia, and a leucocytosis slightly above 10,000. An examination of the abdomen revealed some tenderness in the pelvis, and evidence of a tumor on the left of the uterus. A vaginal examination disclosed the presence of a large, tender,

fluctuating tumor filling the whole left pelvis, and tilting the uterus sharply toward the right. I urged her to go at once to the hospital, assuring her that there was a large pelvic abscess which might rupture at any time and produce irremediable damage. She insisted, however, upon returning home. On the following day she went to the hospital on the street cars, and twenty-four hours later, after thorough preparation, I made a vaginal section and drained the large abscess which I had recognized in the left pelvis. Under chloroform anesthesia, two other masses, some distance from the uterus, could readily be made out. I therefore made a laparotomy in the median line, and after breaking up some adhesions, opened two other abscesses located some distance from the larger one, and in doing so I ruptured the intestine. A through and through tubular drain was so placed as to pass through all three of these abscess cavities, and the general peritoneal cavity was walled off from the tube by iodoform gauze drains. Following this operation the improvement of the patient was most rapid and satisfactory. She remained in the hospital, however, six weeks on account of the necessary dressing of this long sinus, which showed a fecal fistula a few days after the operation. In August she made a long visit in Colorado and California, and has since that time been able to teach regularly in the public schools.

It is possible that a general peritonitis could be instituted without a rupture of the appendix. This peritonitis would then be comparable to the idiopathic peritonitis of the ancients. Before a postmortem could be made, the appendix itself might have discharged its contents into the colon, and all evidence of the primary focus become obliterated. Cases of this kind are certainly conceivable, but fortunately none has ever occurred in my own experience.

Gangrenous appendicitis is a form which occurs whenever through sudden and absolute obliteration of the valve of Gerlach the appendix becomes an over-

distended retention cyst. The wall of the appendix is then in the same condition as the strangulated intestine within a hernial sac. It becomes quickly infected by its contained microŏrganisms, and the veins are filled with infected thrombi, which advance into the mesentery. The gangrenous appendix is quickly surrounded by an abscess, at first containing only such microŏrganisms as escape through the intercellular lymph spaces of the viscus; later, when the defects in the wall of the appendix become macroscopic, putrefactive bacteria and fecal matter, with all their contained microŏrganisms, escape into the surrounding abscess. The same condition may result without much over-distention of the appendix when the mesentery is surrounded with infection, and thrombosis of the mesenteric veins is the initiating pathologic lesion.

In either of the preceding cases the appendix is sometimes found absolutely loose, floating in the surrounding abscess; and sometimes simply attached by shreds of tissue to the head of the colon or to adjoining viscera.

The condition of the patient is not much changed by the fact that the appendix is gangrenous. The only possible dangers which attend this form of appendicitis that are not present in the other forms depend upon the more virulent forms of infection which may escape from the interior of the appendix, to the danger of thrombosis from extension of thrombi in the mesenteric veins, and to the difficulty of removing fecal concretions when the abscess perforates into a bowel or is opened by simple incision.

One of the first operations for appendicitis which I ever witnessed was a case of this kind. The patient was the wife of a doctor, and had been suffering for a considerable time with abdominal pain, with chills and fever. She was in extremis, and when Dr. Fenger was called to see her he decided that an operation under such unfavorable conditions was contraindicated. The husband of the patient, however, insisted that his wife should have the advantage of an operation. With chloroform anesthesia an oblique incision was made in the right iliac region, and a large quantity of seropurulent effusion was discharged, in the midst of which appeared a black, worm-like appendix almost as large as the index-finger. No attempt at irrigation was undertaken, and the abdomen was drained with large quantities of iodoform gauze and one or two glass drainage tubes. The patient made an uncomplicated recovery, and was delivered of a child about six months later.

CHAPTER III

OBSCURE FORMS OF APPENDICITIS

Failure of classic symptoms in many cases; chronic appendicitis manifested by remote systemic effects; by gastric disturbance; illustrative cases; by renal symptoms; illustrative case; by the typhoid state and pulmonary symptoms; illustrative case; by nervous disorders; illustrative case.

It is possible that in the foregoing pages the idea of appendicitis as a clinical manifestation has been more or less vividly presented. It were well if the number of illustrations could be multiplied and the ordinary symptoms and manifestations of the disease more persistently presented to the mind. Probably the picture of appendicitis which the previous chapter has outlined is the one most generally accepted by the professional mind. The every-day practice of medicine, however, brings before the physician a great number of cases which manifest such indistinct symptoms that no diagnosis is made. The patient is sent away with symptomatic treatment, some laxative is given, some remedy supposed to diminish the symptoms of dyspepsia, or some tonic to relieve the unsettled condition of the nervous system. If the physician keep these cases in mind he will mark that sooner or later he is called upon to treat these patients for severe abdominal disease, of which none is more

frequent than that of the appendix. He then recognizes the fact that the gastralgia, or the neurasthenia, or the hectic, which resembled or suggested pulmonary tuberculosis, was really a symptom of chronic appendicitis.

It is not alone from the consideration of clinical experience that this view of appendicitis is forced upon the mind. Every pathologist is aware of the far-reaching and general influence of any particular local disease. Disease of the kidneys, of the liver, and of the other digestive apparatus may be due to so remote and such a local condition as suppuration in the antrum of Highmore, or to that change in the thyroid which is termed exophthalmic goitre, and it is not at all unusual to find the function of the whole digestive tract upset and distorted by a process of chronic suppuration in the appendix or gall-bladder.

It was my rare privilege to be a student and assistant of Dr. Christian Fenger in 1886 and 1887, and take part in his surgical practice and his literary work. At that time he was devoting a large part of his time and attention to the study of the surgical diseases of the abdomen. As I remember it now, appendicitis then appeared to him as a disease requiring surgical treatment only after the establishment of the diagnosis of a periappendicular abscess. He recognized the fact that it required weeks, months, and sometimes years of appendicular disease to prepare the way for the periappendicular abscess. He recognized the fact that the longer the disease continued the more dangerous became each succeeding attack. The reason that appendicitis in its early stages seemed

to him an unfit province for surgical adventure rested upon the dangers which attended any laparotomy in the early 80's and 90's. In the succeeding eighteen years such marvelous improvements have been made in surgical technique that the abdomen is opened with relative impunity, and a larger and larger number of diseases have passed from the domain of medicine into that of surgery. It even has resulted in the disappearance of that sort of emergency in which most of the operations about the appendix were formerly undertaken. Perityphlitic abscesses are relatively rare, and their treatment has become almost as small a part of surgery as the treatment of suppurating compound fracture by amputation, or the drainage of brain abscess for disease of the antrum.

To the majority of practitioners to-day appendicitis becomes a surgical disease only when the patient suffers intolerable pain, or has such violent attacks of infection as to interrupt his daily occupation. The result of operative treatment in such cases is looked upon as better when the symptoms have been allowed to subside, and the operation is undertaken in the so-called interval between attacks. Leaving out of discussion all cases of periappendicular abscess and acute obstructive appendicitis, so readily recognized, there still remains a vast number of patients suffering of this disease who manifest scant symptoms of peritonitis, and no very pronounced symptom of infection or appendicular spasm. It is my purpose here to call attention to the manifestations of chronic appendicitis, especially those resulting in disorders of digestion and asthenic perversions of the functions of the nervous

system. These are probably the manifestations of a chronic intoxication.

Such forms of chronic appendicitis naturally divide themselves according to their symptomatology into two groups. In the first group the symptoms are most forciby manifested in the digestive tract. In the second group the more prominent symptoms are exhibited by the nervous system.

The dyspeptic is the most helpless and pitiable of all patients; he consults every physician and tries every quack method, sometimes with temporary and sometimes with no result. Without much regard to kind or quality his food distresses him, sometimes at once, sometimes several hours after meals. All the ordinary tests of the stomach's competency are answered with conflicting results. He presents a slight hyperchlorhydria to-day, and a normal acidity to-morrow; his stomach is distended in the morning, in the afternoon empty and contracted; for a week he has most violent symptoms, both gastric and urinary, and then for a time all symptoms disappear without adequate cause and in spite of the most reckless indiscretions in diet. Some of these manifestations are attended with febrile fluctuations, while others pursue an afebrile course. Constipation with diarrhea, constipation without diarrhea, and diarrhea without constipation succeed each other in the same case without assignable cause.

Ulcer of the stomach, benign obstruction of the pylorus, disease of the biliary apparatus, and interference in deglutition, are at last excluded. If the abdomen is palpated with such skill and frequency as to

eliminate the superficial reflexes, the right rectus is found uniformly tense and the right peritoneal cavity tender. The abdominal walls will usually be found thinned by the malnutrition of the disease, but in a few cases the opposite condition prevails. The skin is usually soft, toneless, and slightly aged, and frequently there is a duskiness which suggests a faulty biliary excretion. The tongue is apt to be coated and thick, and the patient frequently complains of a bad taste in the mouth. The breath is apt to be slightly offensive, and in many cases there is a pronounced leucocytosis, even in the absence of any disturbance of temperature. In most cases the pulse is slightly accelerated, and after a long attack of indigestion it is irregular and resembles a smoker's pulse. The urine is often high colored, and the patient complains of an irritation at the neck of the bladder and in the urethra. Crystals of oxalic acid are found, especially in heavy adults, with an excess of the normal constituents of the urine.

With these symptoms and findings the patient frequently gives a history of one or more attacks of violent colic or of deep protracted abdominal tenderness, or other symptoms which would suggest a mild circumscribed peritonitis or perityphlitis. These gastric or abdominal symptoms are often combined with those described in the succeeding paragraphs presented by the nervous system.

When the appendix of such a patient is examined by an autopsy in vivo, it is usually found to be long, perfectly free, rather pale, and somewhat thickened; a little longer and a little smaller than the index-

finger, and covered with a network of enlarged blood-vessels, presenting somewhat the appearance shown in the accompanying sketch, Fig. 22. Its mesentery is usually filled with enlarged lymph glands, and a bunch of enlarged glands is to be found in the ileocolic mesentery. Occasionally there are some adhesions left from the primary acute attack. The appendix is composed of thickened and infiltrated muscular tissue, with an atrophied mucosa, a degenerated and highly vascular submucosa, and a thickened and sclerotic

Fig. 22. The appendix of a patient suffering of chronic appendicitis, with symptoms of indigestion.

serosa. In heavy adults a mass of fat fills the mesentery of the appendix, and in some cases the obliterating process has begun, presenting an appendix resembling that in Figure 23, drawn from Fowler. If a microscopic study of this appendix is made, it will present all the evidences of a chronic inflammation, with a more or less extensive sclerosis, and atrophic degeneration of the normal elements of the ideal intestinal wall. The muscles will be represented by a band of connective tissue, in which a few shreds of muscle fiber remain. The submucosa will be devoid of the characteristic lymph glands of the appendix and muscularis mucosæ, and will be filled with blood-vessels whose walls show an advanced stage of arteriosclerosis, Plate IV and Fig. 24. The mucosa itself will

present little of the normal redundancy of columnar epithelium, and will be flattened out and resemble somewhat the epithelium of the urinary bladder. All of these anatomic and microscopic findings point to the extreme inelasticity of the appendix and to its utter incapacity to withstand any violent inflammatory reaction. They intensify the results of clinical observation, that such an appendix can no more be trusted to withstand an acute inflammation than can a gall-bladder when in similar condition.

Fig. 23. An appendix cut open, showing an obliterating appendicitis.

The danger and the symptomatology of such a case cannot be better presented than by recounting the following observation which tragically illustrates this clinical manifestation.

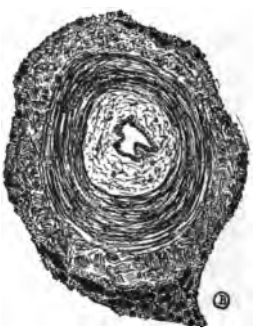

Fig. 24. Cross-section of appendix, showing results of chronic appendicitis, with general sclerosis of the appendix. (Drawn by J. D. Blything.)

In August, 1897, I was called for the first time to see the newly elected president of a large municipal corporation. It was early in the afternoon, and I found him absolutely naked in his bed trying to endure the heat of an excessively oppressive day. He had an alarmingly distressed look, and was of a slightly dusky color. He was nervous, irritable, and anxious. He weighed about 160 pounds, although his height would call for a normal of 15

or 20 pounds more. His temperature and pulse were only slightly above normal. He gave me an account of his medical history. He had been a country-bred, a healthy and hard-working man until he was about 30. At that time he had an attack of indigestion, dyspepsia, and abdominal distress, which laid him up completely and compelled him to spend six weeks at a sanitarium in convalescence. During the subsequent five years he had been obliged to spend two and sometimes three periods each year in similar treatment, and had at last restricted his diet to vegetables, and sometimes to the most artificial "vegetarian preparations." He was able under such a regimen to keep at work for several months at a time, but never with any great amount of strength or vigor. He usually became irritable and exhausted toward the end of the day, and found himself unequal to the unusual duties of his position. Since the first attack he had never suffered any violent abdominal distress, nor did he have any pain except immediately after eating. The distress which he experienced seemed to be due to the distention of his stomach with food and gas. This condition was relieved, sometimes by vomiting and sometimes by washing out the stomach. He had letters and the records of examinations of his blood, urine, and stomach contents covering most of the periods he had spent in the sanitarium.

In making my examination I found that he had a perfectly developed respiratory apparatus. His chest was broad; his inspirations full and complete; his heart free from any organic disease, in spite of the fact that he frequently suffered of palpitation, especially late at night. His extremities were muscular and perfectly well developed, and he had no adenopathy or scars from any venereal or skin disease. His examinations showed a persistent leucocytosis, an occasional hyperchlorhydria, but never anything excessive; a slight anemia, and occasionally some trifling abnormal condition of the urine. His abdomen was tender, and the abdominal muscles were more rigid than normal. He had become accustomed to massage, and had unusual control over his muscles under palpation. With his coöperation I was able to palpate nearly every abdominal organ. Going back and forth over the right iliac region I found

a tender, perfectly recognizable mass, which I believed to be the inflamed vermiform appendix. It was exquisitely tender, and unusually permanent in its location.'

With this history, and with a perfectly negative examination as regards every other hypothesis, I made an exclusive but relative diagnosis of chronic appendicitis, and explained the symptomatology and course of the disease to my patient. I tried to show that his condition was one of inestimable danger, growing greater and more imminent every day with the sclerosis of the appendix and the disappearance of its elasticity. I urged that he should go to the hospital for operation as soon as the exigencies of his newly acquired position would permit, and that until that time he should eat everything that was set before his family, or brought upon the table for his colleagues. A few days afterwards his secretary came to my office and paid my bill, expressing at the same time his employer's appreciation of my advice and his intention to follow it.

I didn't see my patient again until Christmas time, 1897. I accidentally met him on a street corner, and found him rosy, considerably heavier, and more vigorous than when I was called to him in August. He expressed great satisfaction with my advice, and said he had eaten every meal since my visit, and never suffered the slightest distress or indigestion. He declined, however, to submit to an operation so long as his splendid health continued. I urged him, nevertheless, to have the appendix removed, as I believed it was no less a menace to his life than in August.

My next call from him was in April, 1898. His little boy called me up by telephone at two o'clock in the morning, and informed me that his father was suffering with a terrible belly-ache, and wished me to come at once. He told me that another doctor had seen him, and had given him an injection of morphine, and that his father was now in a bath-tub of hot water to relieve pain. From this report I made my diagnosis, and immediately called up my assistant and told him to prepare the operating room at the hospital for an emergency operation during the next two hours. When I arrived at the patient's house I found the perfect picture of rupture of the appendix,

and general peritoneal shock. The patient had returned from business late in the evening; he had slept well for two or three hours, when he was awakened by abdominal pain; this pain was first felt at the pit of the stomach, and afterwards was confined to the region of the appendix. He had attempted to wash out his stomach by drinking a large quantity of salt water. In one of his fits of vomiting and retching he had an agonizing thrust in the abdomen, and nearly fainted away. He sent for the nearest doctor, and received a hypodermic injection of morphine. This did not relieve him, and an hour later he sent for me. I found his pulse 120, and his temperature 103. He was in great mental confusion, and his abdomen was exquisitely tender, and considerably tympanitic. I presented the gravity of his case as positively as I could, and urged an immediate operation either at the hospital, or, which seemed to me safer, at his house. He refused both, and insisted upon having a consultant. I attempted to leave the case, but he insisted upon my remaining. The consultant arrived five hours later, at seven o'clock in the morning, and the patient was operated upon an hour later. I gave the chloroform myself. The operation disclosed a general peritonitis, with a perforated appendix lying over the ileocecal valve. There were many slight adhesions indicative of previous disease. The patient died within 24 hours.

Unless the examination of the stomach and the stomach contents, or the excreta, is distinctly suggestive of disease, it would seem unreasonable in these common cases to make an exclusive diagnosis of gastritis or dyspepsia, and allow the patient to go on without an effort to exclude the more likely diseases of the appendix or gall-bladder. Nothing is easier than to turn off a patient without ever making an abdominal examination, or properly considering the symptoms of his disease, with a diagnosis of gastralgia, neuralgia of the stomach, gastritis, or dyspepsia.

In 1895, N. J., a hard-working and well developed Swede, about 22 years of age, consulted me in regard to pain in the right side, which was almost constant, and disturbed his digestion to such a degree that he was unable to eat any breakfast at all, and very little dinner and supper. His work was very severe, and he nibbled sandwiches, drank hot milk, and ate dry fish in the intervals of his work. He had always been a moderate beer drinker, but for several months had found it almost impossible to drink even half a glass of beer without producing great distress in the abdomen. I had frequent opportunities of examining him. He never had any temperature, although he learned to use the thermometer himself, and took his temperature at frequent intervals during the day. His pulse was never disturbed by the pain. His symptoms had gradually grown worse for more than seven months, but at no time had he suffered any acute attacks which could possibly be referred to the appendix. He never vomited, but he often spit up food.

In making the physical examination I was unable to lay my attention upon anything very definite. His tenderness over the abdomen was not localized at any one place, but seemed to cover the whole right side, both in front and behind. The pains which he had after eating radiated over the crest of the ilium, on the inside of the thigh, and occasionally into the right testicle. This symptom combined with the considerable hypertrophy of the heart led me to think of a renal calculus. The X-rays were not then available, and finding no indication of disease in the urine, I resorted to catheterization of the ureters with the Casper instrument, which I was using at that time. After nearly two weeks of preparation and endeavor, I succeeded in catheterizing both ureters. The patient was extremely helpful, and allowed the introduction of sounds until the urethra was sufficiently dilated to permit the use of this rather large and clumsy instrument. The catheterized urine, with the bladder full of methyl blue, was equal in quantity and similar in character from the two kidneys. This procedure disposed of any suspicion of disease of the right kidney.

With a relative diagnosis of appendicitis, I opened his abdomen at St. Luke's Hospital, and found a very large retention cyst

of the appendix. The appendicectomy was then performed with a ligature about the stump. On the morning after the operation the patient had a sudden rise of temperature, and a considerable pericecal pain, and I was obliged to open the wound for drainage. I found the region of the operation bathed in a dark, seropurulent fluid. The wound was carefully sponged out and a gauze drain placed in the neighborhood of the cecum. The fall of temperature was immediate, and the drainage produced no delay in recovery. During the following seven years he remained in Chicago, and was able to work and eat, and was entirely free from all abdominal disturbance.

In the preceding case the symptoms and findings pointed indefinitely toward the right kidney, and yet the operation demonstrated the extreme pathologic condition of the appendix, and the subsequent clinical history showed that the cause of the complexus of symptoms had been removed. In other cases the most prominent gastric and abdominal symptoms may become obscured by some more alarming symptom calling attention to accidental disease elsewhere in the body, or to conditions secondary to the toxemia. To these secondary symptoms too much attention may be devoted, and a diagnosis of some common or likely condition may be erroneously made. The variety of pitfalls into which the diagnostician may fall is almost limitless. The following case illustrates a series of errors. In the beginning the patient was believed to be suffering of typhoid. Afterward his cough and thoracic pains made probable the diagnosis of tuberculosis of the lungs. And last of all the location of the tenderness, and the appearance of albumin, pus, and casts in the urine gave a suspicion of either suppurative disease of the gall-bladder or partial pyonephrosis of the right kidney.

Mr. S. was a medical student, 24 years of age, five feet eleven inches in height, and weighed about 125 pounds. Most of his life, up to the age of 21, had been spent on the western plains. He had had all the ordinary diseases of childhood. In 1898, after sleeping out at night, as was his custom, he suddenly became very ill, was unconscious, and had retention of urine, and probably some abdominal disturbance. In 1899 he had a rather sharp attack of typhoid fever, from which he made a good recovery. Later he sustained an injury to the urethra at the junction of the membranous and pendulous portions, which resulted in hemorrhage from the urethra, and was followed by stricture requiring dilation for nearly a year. In the summer of 1902 he had an illness initiated by a chill and fever, and followed by abdominal tenderness and distress, distention, vomiting, and diarrhea, and a persistent leucocytosis ranging between 12,000 and 20,000. During the interval between this attack, and the time he entered the hospital, a period of six months, he had suffered of abdominal disturbance, occasional chills on going to bed at night, and on at least one occasion he had fever following a chill. The leucocytosis persisted during all this time, and for three weeks before entering the hospital he suffered considerably from a protracted diarrhea. During all these sicknesses there never had been anything which would indicate kidney or ureteral disease, neither the presence of pus in the urine nor the presence of pain in the testicle, penis, or inner side of the thigh. Albumin and casts were repeatedly found in the urine during this interval. Pus was also found, but this was repeatedly demonstrated to be of gonorrheal origin.

Mr. S. entered the hospital on December 12, 1902, in a very weak and exhausted condition, complaining of pain and tenderness in the abdomen, and a very troublesome diarrhea. His temperature was 98.4; pulse, 70; respirations, 24. The diet ordered was a glass of hot milk with lime water, every two hours. Physical examination showed that there was no valvular lesion of the heart, no evidence of synovitis in any joint, and no evidence of pus-microbe or other infection of any of the sinuses of the head. There was an area of apparent bronchopneumonia in the upper apex of the right lung, which was never

demonstrated to be tuberculous, but which Dr. Robert H. Babcock suspected might be tuberculous. The urine contained a small amount of albumin and a few hyaline and granular casts. Examination of the blood showed 5,464,000 red cells; leucocytes, 11,000; hemoglobin, 80 per cent. I thought the trouble to be distinctly a suppurative disease as against tuberculosis in that it was attended by chills and fever, acute and chronic stages, and a continued leucocytosis. An examination of the abdomen showed that the point of greatest tenderness had never moved far from the region of the gall bladder, right kidney, or appendix. It seemed too high for the appendix; it had been free from ureteral symptoms, and I thought it to be a suppurative disease of the gall bladder.

On December 19th, after a week's stay in the hospital, during which time most of his symptoms had disappeared excepting the localized tenderness, he was prepared for operation. A vertical incision, about an inch and a half in length, was made at the outer border of the right rectus muscle, beginning just below the costal arch. I inserted my index-finger into the wound, and felt a soft and normal gall bladder and the smooth border of the liver. The kidney was fetal and of normal size, and I could feel the pulsating renal artery and the right ureter, which was not thickened nor enlarged. On withdrawing my finger from the wound the appendix came out through the opening. It was at least four inches long, adherent all the way around to the ascending colon, and the peritoneum covering the appendix, and ascending colon was very much inflamed and injected. The appendix was removed, and the skin closed by a single subcutaneous silkworm gut stitch.

During the first 48 hours following the operation he was given several hypodermic injections of morphine for pain occasioned by flatus; but on the third day he complained very little and looked very much better. He became quite constipated, and it was necessary to give glycerin enemas, and later to administer calomel and magnesium citrate. On the seventh day the subcutaneous silkworm-gut stitch was removed, the pain and tenderness in the abdomen had almost entirely disappeared, and he was allowed solid food. A blood analysis on the seventh

day showed 17,000 leucocytes; on the eleventh day there were only 11,250. He left the hospital on the thirteenth day feeling quite well. I have seen him often since he left the hospital, and he has continued to gain steadily in weight, and has a good color. His leucocyte count ten weeks after the operation was 9,400, and the area of apparent bronchopneumonia in the upper apex of the right lung had entirely disappeared.

In the preceding case the most remarkable complexus of symptoms was presented, and few would believe that so small a focus of infection could give rise to so serious and threatening an indisposition. Probably, however, every physician of long experience and close observation will remember one case at least where a trifling infection about a finger nail or ingrowing toe nail or ala of the nose has resulted in the most serious nutritional disease, and he may be able to compare such a case with one in which the appendix is infected. It is not my purpose to refer frequently to the opinions of other writers, but I cannot resist copying almost verbatim from a passage in which Herman Mynter discusses this subject. (Appendicitis and its Surgical Treatment, Third Revised Edition, 1900, p. 87):

"Clinically, however, chronic recurring appendicitis is of great importance, as it may keep the patient in a state of chronic invalidism. I have no doubt that numerous patients are treated for so-called nervous dyspepsia who simply suffer from a chronic recurring or obliterating form of appendicitis. I have seen and operated upon a number of such cases, with the result that they recovered perfectly after the diseased appendix was removed. I will mention one of these cases by way of illustration:

"Mr. A., a young lawyer, 27 years of age, had suffered for four years from severe cardialgia, eructations, and dyspeptic phenomena. He had lost forty pounds in weight, and looked pale and anemic. The contents of his stomach had frequently been examined with negative result, and a diagnosis of nervous dyspepsia made. He had spent one year in New Mexico, going around on horseback in order to use the healing power of nature, and one year in Europe for recreation, and to endeavor to forget his suffering. He had visited different baths both in Europe and America, lived for months on a milk diet, made long sea-voyages, and had washed his stomach out for weeks at a time. He had consulted the most distinguished specialists both in America and Europe, and they were unanimous in the diagnosis of nervous dyspepsia. He consulted me on passing through Buffalo. I found a hard, tender, and swollen appendix, pressure on which produced vomiting and cardialgia. He had never to his knowledge had appendicitis, and was much astonished when I told him that he undoubtedly suffered of chronic appendicitis, and would recover only by its removal. I removed the appendix shortly after, and found it seven inches long, and buried in old, dense adhesions. It contained a total stricture or obliteration one inch long, and on its distal side a dilation, with a coprolite. The operation produced a violent attack of cardialgia, lasting some days. He rapidly improved thereafter, gained forty pounds during the next six weeks, and has been well since. Having operated on a number of similar cases with prompt and perfect results, I have been led to consider the diagnosis 'nervous dyspepsia' with a good deal of skepticism."

Mynter recounts a number of cases of a similar kind, and quotes a number of authors who have made remarkable cures by the removal of the appendix, even in cases of uncontrollable vomiting.

Either secondary to disturbances in digestion, or as the immediate effect of the toxemia of chronic appendicitis, patients manifest the most varied though somewhat characteristic nervous symptoms. The

patient is usually anxious and consults his physician on account of irritability, sleeplessness, and general mental and emotional distress. He is extremely sensitive and feels criticism and unfavorable remarks acutely, and is unable to throw off the despondency which they often arouse. He perspires easily and has indistinct pains in the face, chest, back, and extremities. There is a peculiar feeling of thickness of the scalp and consciousness of his clothing. The hands and feet are moist, and this moisture greatly distresses the patient. He frequently eructates without cause, and these spasms of the abdominal, diaphragmatic, and esophageal muscles are sometimes accompanied by swallowing of air. Distress in the upper part of the abdomen, hardly to be counted pain, is a common symptom, and many patients complain of a peculiar neuralgia over the crest of the ilium and on the outer side of the right thigh. The pupils are usually dilated, and the patient has nearly all the characteristics of a neurasthenic. These cases are difficult to diagnose, and only the most careful consideration of the patient's general condition, his former history, and a critical study of his temperature and blood findings during an exacerbation, can possibly reveal the true condition.

As an illustration of this form of appendicitis, I will briefly relate the case of Mr. Y. He was a medium-sized man of 32, happily married and well established in business. He suffered of a pulmonary hemorrhage four years prior to his consultation with me, and had spent every winter since in an outdoor life in northern Wisconsin. His business required his absence from home on long trips to distant parts of the United States. He had suffered of several painful febrile attacks during the past six years. They usually came on after the hardships of a long

journey, or a change in diet. He consulted me on December 5, 1903. While away on one of his trips in the South he had an indistinct abdominal discomfort, with a slight rise of temperature, and great mental depression. His discomfort was so great that he abandoned his business projects and returned home. His temperature on arriving was less than 100, and his pulse, responsive to his emotional changes, varied irregularly between 80 and 104. He was profoundly despondent, and had been sleepless for more than half the night during several months. His skin presented a slightly cachectic color, and his tongue was coated and thick; he had little desire for food. Although his business presented few complications, he had unnecessary anxiety and worry over these affairs. He was extremely anxious about the condition of his lungs, and he complained of indistinct pain in his back, in the lower part of his chest, in the lower region of the abdomen, and down the legs. On examination I found that his whole musculature was soft and flaccid; his skin was moist, and his hands were particularly clammy; his pupils were moderately dilated, but they reacted promptly to light; the sinuses connected with the nose were open and translucent. The chest showed only the slightest evidence of old healed tuberculous disease. There was no valvular lesion of the heart. The right side of the abdomen was somewhat more rigid than the left, and there was a very distinct area of tenderness in the right iliac region. The examination of the blood showed a distinct leucocytosis, and the temperature continued during the following week at least a degree above normal every night. He had no further attacks of pain; but on each subsequent examination I became more and more convinced that he was suffering of a chronic appendiceal toxemia, which together with his business cares had produced a neurasthenia, for which the only rational remedy was appendicectomy. One week after my first examination, on December 15th, after the usual stay of 24 hours in the hospital, with laxatives, enemas, and preparation of the skin of the abdomen, he was operated upon under chloroform anesthesia. An incision one inch and a quarter long over the outer border of the right rectus muscle, an inch and a half above the crest of the ilium, gave access to the fascia.

This was divided, the rectus pulled aside, the fascia and peritoneum opened, and the very extensively adherent appendix brought into the wound. The mesentery was ligated with catgut, the appendix was cut away, and the stump of the appendix inverted, and the opening and all the denuded surfaces closed in with fine silk, in three layers of sutures. The peritoneum was closed with fine catgut. Two larger sized catgut stitches brought the fascia of the rectus together. The skin was closed with four silkworm-gut stitches. A large antiseptic dressing covered all. The operation lasted seventeen minutes.

The patient vomited several times during the afternoon and night, but in the morning he was able to sit up in a chair for an hour, and began to take nourishment toward the end of the day. He sat up to eat his meals on the second day, and put on his clothes and walked about the hospital on the third day. The silkworm-gut stitches were removed on the fifth day, and he left the hospital on the morning of the sixth day, one week after his admission.

Most striking improvement showed itself in his condition when he began to walk around on the third day. His mental depression and sleeplessness gave way, and his complexion improved; he became more hopeful and sane.

CHAPTER IV

THE SYMPTOMATOLOGY OF APPENDICITIS

Subjective symptoms: pain; nausea and vomiting; faintness; diarrhea and constipation; chill; head- and backache; gastric disorders; cutaneous signs; somnolence and insomnia; night-sweats and cough.

Objective symptoms: posture; temperature; pulse; leucocytosis; tumor; abdominal rigidity; local tenderness.

The trend of instruction in our medical schools, and the accent placed upon laboratory investigation and bacteriologic and chemical examinations in the publications of our medical societies, have turned the attention of most practitioners of medicine from the study of subjective symptoms and concentrated it upon a few objective symptoms and pathologic conditions. There is no disease in which the value of symptomatology is more manifest than in appendicitis. It is, however, a disease in which individual symptoms can be interpreted only when operation is done at the proper moment, and even upon patients in whom the disease is unsuspected. It therefore behooves us to pay the greatest possible attention to the history of the patient and the subjective symptoms which he may offer where there is the slightest hint of disease of the abdominal organs. Too much stress and too much time cannot be placed upon the proper method of calling out the symptoms and the correct

interpretation of them when compared with the examination, the investigation of the secretions and excretions, the study of the blood and the other objective findings. The greatest possible care should be taken in so eliciting these symptoms that no hint of the diagnosis and no suggestions of the symptoms sought for should be conveyed in the question itself. Time is usually well spent if the patient is allowed to describe carefully, with date and place, the course of each of his sicknesses and the incidents and experiences relative thereto.

THE SUBJECTIVE SYMPTOMS OF APPENDICITIS

Pain is one of the most common and invariable of the symptoms of appendicitis. It is sometimes the only symptom, being accompanied by no rise of temperature, nor by nausea or vomiting, nor by the signs of systemic infection. In this respect it is analogous to the pain of certain forms of cholecystitis. In such a case it is probable that the mucous membrane of the appendix is intact, and the muscular wall greatly hypertrophied. When the valve of Gerlach becomes completely obstructed the violent efforts of the appendix to empty itself result in agonizing pain, or the periappendicular peritoneum becomes inflamed and the movement of adjoining intestines produces friction pain, or the adjoining intestine suffers a circular paralysis from a limited peritonitis and its own violent peristalsis produces a true colic.

It may be questioned if the appendix has any sensation at all in its normal condition. Many cases of

rupture, or even gangrene of the whole organ, have run a painless course. I have opened the abdomen under Schleich's solution and found the appendix and adjoining intestine almost completely anesthetic. They could be picked up in the fingers, pinched with an artery forceps, or even cut with the knife or scissors, without any consciousness on the part of the patient. Lennander (Mitteilungen aus den Grenzgebeiten der Medizin und Chirurgie, Band 10, Seite 69) records his experiments which confirm my own observation, and further concludes that the peritoneal coverings of the intestine, the stomach, the urinary bladder, the gall-bladder, and the ventral surface of the liver are completely anesthetic when unmodified by disease, while the parietal peritoneum is exquisitely tender. The origin of the pain in appendicitis is hard to explain, and no absolute demonstration of it has yet been given.

Pain is, however, not an invariable and constant symptom of appendicitis. Many cases are observed in which there is absolutely no complaint of pain, or at least the pain that is suffered is of such a diffuse and general character that it fails to attract the attention of the patient or suggest the idea of appendicitis to the physician. The distress which stands for the pain may be referred to the pit of the stomach and resemble the constricted feeling which follows the eating of chokecherries or green apples, or swallowing of bitter medicine. Many patients suffer no pain at all until pressure is applied over the appendix, or until the appendix leaks or ruptures. If the physician fails to palpate the abdomen, the first suggestion of

abdominal disease in a patient with all the symptoms of severe intoxication may come when the perityphlitic abscess is well under way. In the case of the medical student, Mr. S. (page 70), a slightly tender abdomen and the history of a single painful attack six months before the operation was all the pain that was demonstrable.

If we try to make a picture of the pain of appendicitis as it appears in a composite of a great number of cases, we notice particularly its onset at the pit of the stomach, or even a little lower, in the neighborhood of the umbilicus. This pain is not sudden like that of cholelithiasis or calculus of the kidney, nor is it so sharply remittent. There are periods of exacerbation and remission, and these are influenced by the quantity of food in the stomach and by the temperature of the body. The first onset of pain is usually slow, and attains its maximum only after several hours, and it never completely remits. While the pain is at first referred to the pit of the stomach, it later shifts, with a gradual increase in its intensity, to the region of the appendix. An attempt is made to represent this pain graphically in Plate I.

There are many modifications of this pain which are worthy of notice. Pain in the right testicle, in the right side of the thigh, in the right groin, and even in the small of the back, are of relatively common occurrence. The first of these manifestations has given rise to the suspicion of calculus in the ureter, or to ureteral disease, as in the case of N. J. (page 68), and when accompanied by stone in the urinary bladder it has led me to make a suprapubic

cystotomy after the demonstration by skiagraph of a mass the size and shape of a ureteral calculus in the lower end of the right ureter, and a large stone in the urinary bladder. (International Clinics, Vol. 1, 12th Series, 1902, page 148.)

Mr. A., a locomotive engineer, 38 years of age, had scarlet fever very severely when he was eight years old. At that time his legs swelled, and we concluded he had postscarlatinal nephritis. In his youth he had no serious illness. Several years ago he began to have pain in his right side; on one occasion it was so intense that he was obliged to leave his engine and be carried home. This pain was severe, paroxysmal, and in the right side and back; he does not remember whether it extended into his leg or not. His right testicle had been removed for unknown cause; it had been painful and swollen. He had also undergone an operation for right inguinal hernia; the scar is slight. The heart's apex is three or three and a half inches to the left of the median line, but there is no murmur. During the last four or five years he has suffered great distress in the penis when riding on the engine or even in the cars. The urine contains much pus and some blood, especially in the afternoon. The sound reveals a calculus in the bladder. On palpation over the abdomen an indistinct lump is discovered where the right ureter meets the bladder. This same small mass can be detected by rectal examination, but is not felt plainly enough to satisfy one that it is a foreign body. It feels like an enlarged lymph-gland. The right kidney can be palpated; it seems to be tender. The blood count at 5 P. M. showed 13,000 leucocytes to the cmm. On examination the urine is found to be yellow and cloudy in appearance, acid reaction, a specific gravity of 1,020, with a trace of albumin, but no sugar; its sediment contains numerous pus-cells.

The patient was put on urotropin, five grains in a glass of water every two hours for forty-eight hours, to sterilize the genitourinary tract preparatory to a lithotrity. In considering the source of the calculus in the bladder, the early nephritis, the absence of the right testicle, the scar of the right inguinal hernia, the tenderness of the right kidney, and the peculiar feel-

ing of a nodule in the region of the right ureter were all regarded. On account of the turbid urine, the stone in the bladder, and the unusual sensitiveness of the patient, cystoscopy and the division of the urine by the Harris instrument were omitted. The patient was, however, taken to the Fuchs laboratory, and a number of skiagraphs were made. These pictures showed no shadows in the regions of the kidneys. In one picture, an outline of which is shown (Fig. 25), there was a shadow showing the size and position of the bladder stone and another distinct shadow locating a mass where the nodule could be felt in the region of the right ureter. After considering the history with the new finding, it was believed to indicate a stone in the right ureter, probably at its very mouth. On this account it was thought best to remove the bladder stone by suprapubic cystotomy, and then through the same opening extract the supposed calculus from the ureter.

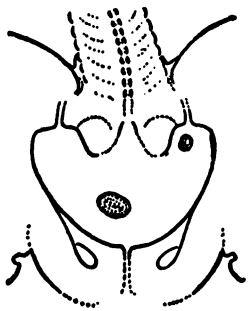

FIG. 25. Outline of skiagraph showing the stone in the bladder and the supposed ureteral calculus.

The patient was anesthetized with chloroform. He did not take it well, and several times it became necessary to draw out his tongue. The operation was performed without delay or accident. The mucous membrane of the bladder was fastened all around to the fascia of the recti. The stone was extracted with smooth placental forceps. The bladder was washed out and explored with the finger, but the small stone could not be detected until the other hand pressed it down from above, and then it felt as if an inch and a half or two inches away. It certainly was not near the bladder wall. On account of its inaccessibility through the bladder an incision was made at the outer border of the right rectus and the stone picked up at once. Instead of being in the ureter, it was found in the appendix (Fig. 26), which was immediately removed and the abdominal wall closed. Drainage of the bladder was established on account of its septic condition. The patient waked and wished to see

the stone while he was still on the table, and before the dressings were put on. Six hours after the operation he began to vomit large quantities of dark coagulated blood, resembling coffee-grounds. This continued for three hours, with great prostration, rapid and almost imperceptible pulse, and at one time even collapse. Three pints of normal salt solution were infused subcutaneously during this period, and the rectum was kept full of hot normal salt solution. For twenty-four hours all means of stimulating the heart and raising the blood-pressure were used, to no avail. He was pulseless at the wrist for more than eighteen hours before his death, which occurred twenty-four hours after operation.

A limited postmortem was made. The abdomen contained no blood or urine, nor any evidence of infection. The bladder was very foul-smelling. The stomach was not examined.

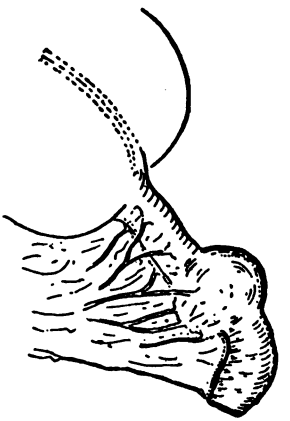

FIG. 26. Showing the position of the stone in the vermiform appendix.

Sudden disappearance of pain must be looked upon as ominous. It frequently happens when the appendix ruptures and a general peritonitis is set up. It occurs when through thrombosis gangrene of the appendix is initiated, and it may result from the extension of a local peritonitis, or the rupture of a perityphlitic abscess.

Although the pain is usually slow in its onset, yet at the time of the examination the patient may be unable to remember anything except the sudden colic, which stands for some period in the extension of the disease. One of my patients who had lost the right

testicle, presumably from tuberculous disease, felt his first pain in jumping from an Illinois Central suburban train. At the operation which I performed some days later three fecal concretions were found in the appendix. Whenever the pains come on suddenly and intermit completely, the gravest suspicion of appendicular origin should be entertained. In my own experience three cases at least have warned me, in two of which symptoms of acute yellow atrophy of the liver came on (see page 213), and in one of which the patient recovered with repeated attacks of jaundice and recurrent, completely intermittent, pain, exactly resembling the attacks which led to operation.

The patient frequently describes the pain as a burning, stinging, biting pain, and in describing it puts the thumb of the clenched fist over the pit of the stomach and twists the hand as if emptying a jar of salve with the thumb nail. The most obscure pains may be due to an appendicitis, and the circumstances of the case may complicate the history and make the diagnosis well-nigh impossible, as may be seen from the following history.

Mr. D., 58 years old, consulted me in the winter of 1894 and '95. He had been under the care of Dr. William E. Quine, who had made a diagnosis of carcinoma of the colon. The beginning of his disease was two months after a railway accident, in which Mr. D. received only trifling injury to his right side over the liver. When I examined him he complained of an excessively tender area covering the ends of the eighth and ninth ribs and cartilages, and this region seemed considerably swollen, hot, and tender. A gurgling sound was constantly heard at this point. The patient complained of a hot, burning pain in the abdomen. It was not located very closely, but appeared to be upon the

right side. His temperature was constantly above normal, and during the last few days while he was in the hospital for examination it reached 101. He had a high leucocytosis, and was moderately anemic. Pressure upon the ribs showed that the eighth and ninth ribs were wholly loose and detached from their cartilage. This was presumed to be a result of the railway accident. Pressure upon these ribs produced exquisite pain. The patient became jaundiced during his stay in the hospital, and vomited excessively for two or three days. With the symptoms of infection, the evident detachment of the ribs from their cartilages, and the exquisite tenderness in that area, I made a relative diagnosis of some pyogenic disease in this region, and recommended an operation. This was done under chloroform anesthesia, and the ends of the ribs resected, the cephalic peritoneal cavity opened, and an accumulation of fetid serum removed This accumulation was believed at the time to be due to injury of the intestine from the separation of the ribs from their cartilages. It was drained, the sepsis disappeared, and the patient recovered. The pain which he complained of continued. He made a business trip in the South, and had malarial fever. Three years later, having suffered this burning, boring pain almost constantly, he was suddenly taken with an agonizing abdominal pain, and eighteen hours later I found him with all the symptoms of a diffuse suppurative peritonitis. With the assistance of Drs. D. H. Galloway and William L. Wilson I opened the abdomen, removed a perforated and almost gangrenous appendix, and drained a large pelvic peritoneal abscess. The patient died twelve hours after the operation.

The pain in this case gave in the first instance, in a man of 58, the general suggestion of carcinoma of the colon, and led to that diagnosis. The acute symptoms of sepsis, which came on either from a leaking of the appendix or a retrocecal abscess, which I drained on the supposition that it was due to traumatism, disappeared, and the patient went through a course of three years, during which his pain was be-

lieved to be largely hysterical. An operation at any time before the perforation of the appendix would doubtless have revealed the true pathology and saved the embarrassing end.

In children at the breast appendicitis produces the colicky baby, and it sometimes so seriously interferes with the nutrition of the child that grave complications follow. The crying results in the production of hernia, and the violent tenesmus combined with emaciation favors intussusception. Dr. W. B. Helm observed a three-year-old boy who had suffered constantly since birth of crying spells, with tenesmus. The mother's milk and the various foods were ravenously taken, but often vomited. There was some fever and little gain in weight. A right inguinal hernia appeared when the child was five weeks old, and seven weeks later the temperature rose to 103, and the pulse ranged above 160, and the child weighed only eight pounds. It cried most of the time. On account of the tenderness of the hernia, which had now reached the size of a hen's egg, Dr. Helm operated and removed a highly inflamed appendix. During the next ten days the child gained two pounds, the crying stopped, and the digestion became normal.

In growing children the pain is rarely complained of until it becomes sharply colicky, but the observing physician and parent will often see the child stop suddenly while eating and drop down in his chair as if nauseated, only to begin eating again when the pain has passed away. In the same way, while at play or engaged in some occupation, the child suddenly loses interest and spirit; a vacant and drawn look comes

over the face, he stops his work or play, to resume it again when the pain ceases.

It is impossible to determine from the pain or its manifestations the character of the disease or the danger in which the patient happens to be. Cases are reported in which the completely gangrenous appendix has given rise to trifling pain, and I have myself observed the most agonizing pain in a case of almost completely obliterated appendix. The patient was a young man of 24, a stoical German, and he was suffering of a second attack. The first attack had lasted two weeks. His second feverless attack had been on only twenty-four hours. The pain was agonizing, and from its very severity produced nausea and vomiting. Twenty-four hours after the beginning of the attack I operated upon him and found a completely buried and almost completely obliterated appendix. It was three mm. in diameter, of a white, cartilaginous appearance, and it lay buried in the edematous and adherent peritoneum of the adjoining intestine. He vomited persistently from the chloroform anesthesia for twenty-four hours, and at the end of that time had a liberal movement of the bowels, got out of bed, dressed, and left the hospital at the end of the fifth day to resume his work. Two other cases with almost completely obliterated appendices suffered the most intolerable pain, with very trifling disturbance of temperature, and in these cases the appendix was covered with peritoneal adhesions of a very light, edematous, and vascular type.

In the case of the mail-carrier (page 39), the pain at the beginning of the attack was quite severe, but

later the whole course of the disease was colored only by a deep uneasiness and tenderness. The course of the most extensive abdominal abscess sometimes runs in an almost painless way, and gangrene of the ileum through thrombosis of the ileocolic branches of the superior mesenteric artery or veins has occurred with trifling pain.

Pain, therefore, must be looked upon as a serious symptom whenever it does occur, but its absence does not preclude the gravest danger, nor promise betterment for the patient as long as other symptoms remain.

After pain the most prominent symptom of appendicitis is related directly or indirectly with nausea and vomiting. Nausea and vomiting are almost as invariable symptoms as pain, but the nausea does not continue so long, usually coming to an end after a few hours; and the vomiting is dependent upon the amount of material in the stomach and the habit or tendency of the patient. The nausea is often mixed in the patient's mind with the pain, and it is frequently produced by pressure over the diseased appendix. It subsides after the formation of protective adhesions, and it is relieved when the stomach is empty. In children vomiting is sometimes the first symptom which calls attention to the disease. It is painful, and is followed by distinct abdominal distress, which causes the child to draw up the leg and protect the abdomen. The vomiting early in the course of appendicitis is quick, complete, and violent, while the vomiting which comes on after perforation and general peritonitis is a sort of painless regurgitation. The foul-smelling intestinal contents are poured out of the

mouth without much retching. Many cases of appendicitis run their course without any nausea, and without vomiting.

Somewhat analogous to nausea is a faintness, a cardiac distress, or even a palpitation, which suddenly comes on with or without appendicular colic. These manifestations are particularly common in neurasthenic and hysterical persons, and in those who are under great mental strain. These symptoms also occur whenever there is extension of the peritoneal infection, and particularly when there is a rupture of the appendix or a leaking of a perityphlitic abscess. In these cases the symptoms go on to collapse, and the patient faints, and is obliged to sit down or falls upon the floor.

Fainting and collapse, especially when they occur repeatedly while the patient is at stool, should give rise to the most careful investigation and to the most potent suspicion of a possible appendicitis.

Diarrhea and constipation, if not symptoms of appendicitis, very often attend it. It is hard to place the proper relation between them and the disease of the appendix. It would seem that constipation and diarrhea, either one or both of them in the same individual, might predispose toward the initiation of the disease; but on the other hand, it is equally clear that appendicitis in its various manifestations gives rise to constipation in one case or at one time, and to diarrhea in another case or at another time in the same patient. The peritonitis which frequently surrounds the sick appendix paralyzes the adjoining bowel, especially the head of the colon, and results in a condition

closely approximating impaction; then the peritonitis passes away, the colon is emptied, and the hyperesthetic condition of the nervous system of the part promotes an initial peristaltic action and a very frequent emptying of the colon, and thus diarrhea and constipation are the result of appendicitis in the same patient. When the appendix is attached to the colon, or to an adjoining intestine, the normal peristaltic action of the colon, or the intestine, initiates an untimely peristaltic action beginning at the attached portion of the appendix, such as might result if the appendix were picked up and pinched with an artery forceps at that moment. This peristalsis is frequently sharp, and accompanied by slight colicky pains.

Chills if they occur are significant of the onset or the extension of infection, of the sudden obliteration of the valve of Gerlach, of the localization of an abscess in a distant part of the abdomen, or of an emptying of the engorged lymph tracts. Chills are not very common in appendicitis, except after the production of a perityphlitic abscess. When the appendix actually leaks, or when a perityphlitic abscess breaks, the patient frequently suffers of a chill. This is, however, not at all in proportion to the gravity of the damage done. It is frequently a simple cutis anserinus. In a case of general peritonitis described in a previous chapter (Dr. B.'s son, page 43), there was no chill during the course of the disease, yet the abdomen was found full of pus; and in another case, which occurred about the same time, the patient had a fainting spell and a partial collapse at the time of rupture, but no chill and no nausea or vomiting.

Chills must be looked upon as symptomatic rather of a localization of infection than of a simple obstruction of the appendix. Nevertheless, chills are occasionally observed in patients in whom nothing more than a simple appendicitis is found. It is possible that the character of the infection determines in a measure the presence or absence of a chill, but so far as we know at the present time no such relation exists. In any case if a chill is present in the history, it must be looked upon as adding gravity to the prognosis, and it should arouse the most careful investigation of the condition of the lungs and other viscera.

Headache, backache, pains in the legs, and even migraine are frequently the result of an intoxication, the primary cause of which is in the appendix. When these symptoms occur with the other symptoms and findings of chronic appendicitis, a reasonable hope of their disappearance after the removal of the appendix may be entertained. The appendicular disease certainly gives rise to the most serious disturbances of digestion and elimination; and the irregular and premature or tardy emptying of the stomach, and the uncertain and tardy discharge of the contents of the colon adds the so-called autoinfection to the intoxication which results from the infection in the appendix. When these symptoms are combined with a variation of temperature from the normal, with an increased leucocytosis, with occasional attacks of abdominal pain, and the more local findings of the disease, they add weight to the diagnosis. In some cases at least these discomforts are sufficient to warrant so safe and effective a measure as appendi-

cectomy, providing all other means of relief have failed.

Gastralgia, gastrodynia, gastric neuralgia, gastritis, dyspepsia, and biliousness are terms which are applied to the disturbances of digestion that are referred to the stomach. Perhaps this symptom-complex has been sufficiently elaborated in a previous chapter. It is only necessary here to mention its great prominence and prevalence in cases of appendicitis that wander about from sanitarium to sanitarium, from one method of dietetics to another, from one stage of invalidism to a lower stage, as time progresses. These patients are fortunate if during the course of their disease an acute manifestation presents itself and they fall into the hands of a surgeon and the offending part is removed. Even after this procedure the emaciation, the hyperesthetic condition of the abdominal viscera, and the irritated and depleted nervous system require considerate and protracted treatment.

This condition was very prominent in a case which recently came under my observation:

The patient was a woman of 30, who had been married three years. Ten years ago, while making an excursion on the Mississippi river, she was attacked with a violent abdominal pain, and treated for ten weeks for inflammation of the bowels. A year and a half later she was treated for three months for supposed ulcer of the stomach, and since that time there has never been a period of more than three months without abdominal distress and indigestion, leading to some peculiar dietetic treatment. Starvation is the only thing which gives her relief, although she has been able to eat indiscriminately for a number of days or even weeks without any disturbance or distress. The loss of weight and strength has made her married life unsatisfactory. She has been pregnant only once, and this once was probably terminated

by a severe attack of abdominal pain, presumably appendicitis. During the past three or four years her attacks have been diagnosed appendicitis by a number of very competent and experienced physicians and surgeons. She has had a great dread of appendicectomy on account of the disasters which have befallen her friends and acquaintances, but the interference with her health, her spirits, and her sexual competency has led her to demand the operation. She even insists that if this means is ineffectual in restoring her to vigor, she will insist upon a divorce.

On examination I find a woman of 110 pounds, who ought to weigh 160. Her jaws are so formed as to show the effects of adenoids in early life. Her chest is moderately well developed, and shows no physical signs of disease. The abdomen is very flaccid, and more tender than normal, with a distinct area of tenderness in the region of the appendix, and a perfectly palpable tumor, the compression of which produces nausea and pain at the epigastrium. The pelvic organs were not examined at the time. The pulse was 80, the temperature normal, and the blood count showed 4,800,000 red corpuscules and 7,000 white corpuscules. The examination of the urine was wholly negative.

After twenty-four hours of light diet and the use of a vigorous laxative, she was anesthetized with gas and the appendix removed. On acccunt of the slight question of a possible cholecystitis, the small incision was made rather high up. The appendix was easily brought into the wound, and found to be rather longer than normal, with a thin, vascular mesentery and a greatly distended proximal portion. The distal portion was thicker and firmer, and the general appearance of the appendix led me to believe that it was frequently greatly distended and cystic. The mesentery was ligated with catgut; the purse-string suture about the base of the appendix was fine Florentine silk. The stump of the mesentery was completely covered with fresh peritoneum. The little incision in the peritoneum was closed with fine catgut, the fascia brought together with three coarser catgut stitches, the fat was held together with a single fine catgut stitch, and the skin brought together with four silkworm-gut stitches. In spite of some delay on account of the incompleteness of the

anesthesia at the time it was necessary to bring up the peritoneum, the operation required only eighteen minutes, and the anesthesia was of twenty minutes' duration.

The next day the patient sat up, walked about the room, and although she had suffered some abdominal pain, she slept at intervals during the night, and had not vomited. She left the hospital at the end of the fifth day, and during the following year gained in weight and strength, recovered her sexual power and interest in life, and divorce proceedings are no longer considered.

This case is significant in many particulars. In the first place the long-continued invalidism, with dyspepsia as the most prominent symptom, had nearly undermined not only the life and happiness of the patient, but that of the family. The repeated attacks of appendicitis called out the diagnosis at various times, and at various places, but until the abortion and the fear of continued sexual incompetency the patient would not hear of a surgical operation. The long-continued cystic condition of the appendix had produced distention of the proximal portion, atrophy of the lymphatic and muscular elements, and the production of a sclerosed cyst, which was liable to rupture or perforation through anemic necrosis on the slightest provocation. The use of gas seems to have resulted in a limited amount of nausea and no vomiting, although it protracted the operation by several minutes. The complete enclosure of the raw mesenteric stump and the very thorough manner in which the stump of the appendix was turned in; the small opening in the parietal peritoneum and its complete closure with fine catgut, and the trifling amount of traumatism which was inflicted upon the intestines, made the pain less, the probabilities of peritoneal

adhesions very slight, and gave an opportunity to put the patient quickly upon her feet and break up in the most abrupt and radical manner the ten-year-long habit of invalidism. The shock to the intellect which the operation afforded was taken advantage of to overcome the self-centered habit.

Cutaneous hyperalgesia has been noticed very frequently in cases of appendicitis. It is elicited by gentle friction, by pinching the skin, or by passing the head of a pin or some blunt instrument over it. It occupies a limited triangular area above the ileac crest on the front of the abdomen, and occasionally a small circular area can be noticed in the small of the back. The sudden disappearance of these areas of hyperalgesia is thought by Musser to promise gangrene of the appendix.

Somnolence on the one hand and sleeplessness on the other are occasionally noticed as symptoms of infection within the appendix, but they are not nearly so pronounced in this disease as in infection of the biliary tract and the nasal sinuses.

Night sweats after a diurnal rise of temperature are extremely common in chronic appendicitis, especially in vigorous young people. When these symptoms are accompanied by a cough and some accidental congestion of the lungs, they are very suggestive of tuberculosis, and mistakes of this kind have repeatedly been made (see case of Mr. S., page 70). The correcting element, leucocytosis, may not be available, for many cases of tuberculous pneumonia are attended by mixed infection, and thus this test is not decisive. In children the sweats and cough are frequently most mis-

leading, and only repeated and very careful examinations with intelligent and watchful observation of the patient will clear up the diagnosis.

THE OBJECTIVE SYMPTOMS OF APPENDICITIS

Some of the symptoms of appendicitis are distinctly objective, and many of the subjective symptoms have almost the value of objective symptoms when adroitly elicited. The method of describing the pain, the gestures and position of the body, add great weight to the mere verbal recitation. Even the dates, the occasions, and the duration of symptoms of a purely subjective nature take on an objective value when judicially considered.

The position of the patient is sometimes quite characteristic and very suggestive, especially in children. The child is taken with a sudden abdominal pain in the midst of play, and immediately lies down on the floor, or on the ground, and bending the chest forward and bringing the right knee in toward the chin. Usually he presses his hands upon the abdomen at the pit of the stomach. In a moment the pain is gone and the child is up and at his play again. The physician will often notice that the patient in sitting lets himself down on his left buttock, and will assume such a position as will flex the right thigh. In ascending a stairway such a patient will bend the body forward as he raises the right foot to the step above, and in his bed he usually brings forward the right leg, and shows a tendency to lie on the right side, because such posture gives more relief to the inflamed and edematous

mesentery. For weeks after a sharp attack of appendicitis the patient walks carefully, something like an old man with an enlarged prostate, and even carries a cane, and swings the right leg a little shorter distance than the left.

An absolute diagnosis of appendicitis can rarely be made, though an absolute diagnosis of a perityphlitic abscess is a simpler matter. Nevertheless, when the symptoms of appendicitis are considered in connection with the physical signs, and when a thorough examination of the rest of the body has been made by a sufficiently careful and experienced physician, the diagnosis is clear and positive enough to warrant the small risk of a skilful laparotomy. The five physical signs of greatest importance are the temperature, the pulse, the leucocytosis, the rigidity of the abdomen, and the tenderness over the appendix.

The temperature curve of acute appendicitis is a sharp rise, followed by a septic variation of temperature during the following four, five, or six days. Still, there are cases of acute appendicitis in which the pain is excruciating, while the rise of temperature is insignificant, or represented by a sharp fall below normal. The height to which the temperature rises at the beginning of an attack of appendicitis is so various that upon this symptom alone no great reliance can be placed. The temperature is often 104 within an hour after the beginning of symptoms, and again, in another case of equal severity and equal danger, the temperature may be not above 101 or 102. In many cases, with the most agonizing pain and with a tympanitic condition of the abdomen, the temperature

may be as low as 99 or 100. The temperature record should always be observed, but it should not be looked upon as pathognomonic or decisive. In chronic appendicitis the temperature is sometimes almost normal during the whole course of the disease, while in other cases the symptoms and the other physical signs of appendicitis are absent, and the temperature is almost the only evidence at hand. Such a case was that of M. K. age 10. He had exhibited a high temperature from the middle of September to the first of February. This temperature was sometimes 104, 105, and 106, and hardly a day passed during these four or five months in which the temperature did not at some time reach 103. It was irregular and septic, and was accompanied by a pulse which varied between 90 and 130. The condition of the abdomen, the absence of pain, and the insignificance of the three or four attacks of obstructive appendicitis, were so obscure that the case was diagnosed as one of tuberculosis of the bronchial lymph glands. In the case of Mr. S. (page 70), the temperature was insignificant as compared with the leucocytosis, and the symptoms of general intoxication. In the case of N. J. (page 68), the constant use of the thermometer during a very severe chronic appendicitis showed no temperature at all worthy of mention, and the case was looked upon as one of stone in the kidney without infection, until after catheterization of the ureters.

The pulse in appendicitis follows the temperature for the most part, and in this respect it is different from typhoid. It is not proportionately so high as is the pulse in tuberculosis with a similar temperature.

There is little or no difficulty in recognizing the rapid pulse of appendicitis, and distinguishing it in acute attacks from typhoid; but in chronic appendicitis the pain is so insignificant, the temperature is so moderate, and the symptoms of general intoxication are often so pronounced, that the slight acceleration of the pulse might cause it to be looked upon as a rather rapid typhoid pulse. Upon the whole, the character of the pulse is not very significant, except as it tends to eliminate typhoid and pneumonia. As the disease advances, and the infection becomes a perityphlitis or general peritonitis, the pulse is extremely rapid, thready, and of the greatest diagnostic importance. Nothing can be more ominous than the sudden appearance of a rapid pulse, with a falling temperature and an increasing leucocytosis, on the second or third day after the appearance of symptoms of appendicitis. This rise of pulse is often accompanied by a collapse, a pronounced sweat, or an actual fainting away, but not always. The pulse must be watched indefatigably if, for any cause, in a case of suspected appendicitis an immediate operation cannot be undertaken.

The leucocytosis is rather an important physical sign and one which is sometimes of the greatest value. It is more prominent in acute than in chronic cases. It varies between 10,000 or 12,000 and 25,000 to 50,000. The relation between infection and leucocytosis does not seem to be as thoroughly understood and explained as is desirable. In the case of N. K., although the temperature was persistently high, the leucocytes never rose above 10,000, and in another case, in which there had been the greatest

abdominal pain, with extremely low temperature, never above 99 or 100, the leucocytes were persistently above 25,000; and directly after the operation for removal of an almost completely obliterated appendix, they rose and remained at 50,000 for three or four days. The presence of a leucocytosis always speaks for some form of infection as against a typhoid, or a tuberculous peritonitis. It must, however, be remembered that in tuberculous peritonitis of children a leucocytosis is occasionally observed. The leucocytes appear within six hours after the beginning of the infection, and they appear more rapidly in proportion to the extent of denuded connective tissue. When the appendix is free from ulceration, the leucocytosis is lower; when the appendix is surrounded by a perityphlitic abscess, the leucocytosis rises very high. In some cases of chronic appendicitis the persistent leucocytosis is a physical sign of the greatest importance, and if the sinuses of the ears and nose, the pleural cavity, the bronchial apparatus, and the gall-bladder and genitourinary tract are demonstrated free from disease, the suggestion of appendicitis becomes very strong. After operation the number of leucocytes usually increases very rapidly for 12 to 24 hours, due either to the administration of the anesthetic, or to the dissemination of the infection by the traumatic insult to the sick and infected tissues. This operative leucocytosis disappears with great rapidity, and if a clean and unlacerated operation has been performed, the leucocytes ought to have disappeared by the end of 48 hours. The diminution of hemoglobin is not a symptom of any significance except in cases of chronic

perityphlitic abscess and chronic appendicitis with dyspeptic symptoms and starvation. It is significant only when the hemoglobin is so low as to constitute an added danger to a prolonged anesthetic and an extensive operation.

Only in advanced cases of appendicitis is the form of the abdomen significant. When a general peritonitis appears, and tympany is present, the abdomen presents a characteristic appearance which is easily recognized when taken in connection with the pulse, the temperature, and the appearance of the face. In the beginning the abdomen presents no characteristic appearance; if anything, the muscles in spare people appear a little better modeled and more distinct. In the flabby abdomens of civilized women and sedentary men, the early recognition of appendicitis by inspection is not to be thought of. In some young people there is an apparent tumor over the region of the appendix, which is not explained by the findings at the operation.

Palpation of the abdomen usually elicits very important signs. In cases of acute appendicitis, while the pain is still felt at the pit of the stomach, the patient lies upon his back, with his hips and knees flexed, and his arms by his side. Palpation shows a considerable tenderness over the whole abdomen, but on the left side the abdominal muscles can easily be pressed downward toward the spine. On the right side of the abdomen there is more or less rigidity. Three fingers are used in palpating. The right hand is placed over the left side of the abdomen, the left hand symmetrically over the right side of the abdo-

men, and deliberate and considerate pressure is made with the left hand until the three fingers come in contact with the posterior abdominal wall; then the right hand is slightly raised, and a similar deliberate movement is made with the left hand. In this way the presence of rigidity of the right rectus is easily recognized. This palpation is repeated several times while the patient is engaged in conversation. It may again be repeated while the patient makes full inspiration and expiration through the mouth; and again with the hands reversed, so as to avoid the error incident to measuring with the right and left hands; and again, perhaps, while the examiner closes his eyes in order to concentrate his attention upon the muscular effort required. These examinations must be performed with the greatest care, and in such a way as to produce the least possible pain and certainly no great pain to the patient.

After palpation has been made to determine the presence or absence of rigidity of the right rectus, the whole field of the abdomen should be very carefully palpated with the tips of the fingers in order to recognize the tenderness which is usually felt over the inflamed appendix. This palpation should be made with two or three finger-tips, and the fingers should remain attached to the skin while they are moved backward and forward over any sensitive or resisting body which might be the appendix. This pressure should not be very great, and ought not to be repeated if it produces severe pain. In quite a large number of spare people the inflamed appendix can be readily palpated. This is especially the case in chronic ap-

pendicitis, and in acute appendicitis with the formation of a large retention cyst. In the case of Mr. S., a spare man weighing 130 or 140 pounds, an appendix could be readily felt under the abdominal wall, and a drawing was made before operation which corresponded very exactly with its size and form. The tumor must not always be looked for in its normal position, but it must be remembered that it may be found in almost any part of the abdomen. While the presence of rigidity of the right rectus is an extremely common and very reliable physical sign, the palpation of a tumor corresponding with the appendix must not be expected in any large proportion of patients, though it should be given some credit when it corresponds with an area of tenderness, and must be regarded as a valuable physical sign in cases of chronic disease of the appendix.

CHAPTER V

COURSE AND SO-CALLED COMPLICATIONS OF APPENDICITIS

Difficulties of prognosis; duration of the disease; its possible complications and uncertain results; cases; relationship of acute and chronic appendicitis; gravity of both conditions; liability to recurrence; futility of all save operative measures; indications for treatment; present tendency in treatment; dangers of delay; illustrative cases.

The course of appendicitis cannot be predicted from the symptoms or the physical findings. The most violent symptoms and the most pronounced physical findings may attend cases that ultimately result in recovery, and the mildest and apparently most insignificant attacks may be attended by the gravest possible dangers, and result in absolutely irremediable conditions. From the respective gravity or lightness of the symptoms no prognosis for a favorable or unfavorable termination can be made, and one sort of clinical picture demands from the physician the same attention as another.

The course of acute appendicitis, or, to state the pathologic condition more exactly, acute obstruction of the appendix, progresses for two, three, or four days, or two, three, or four weeks, and in probably four-fifths of all cases terminates in a temporary and

relative recovery. Under the pressure of the retained secretions of the appendix and the efforts at repair, the valve gives way, the contents of the appendix are discharged into the cecum, and partial recovery follows. Meanwhile the mucous membrane of the appendix has undergone changes; its muscular and lymphatic tissues and its mesentery have become edematous and infiltrated; and the peritoneum has frequently become attached to adjoining organs during the process of infection, with the result that adhesions are formed, the appendix itself is cicatrized, and the mucous membrane so changed as frequently to result in secondary valve formation between its distal end and the colon. In twenty per cent of all cases, or possibly less, the acute appendicitis passes over into more serious conditions; a perityphlitic abscess results, which may go on and produce an irremediable thrombosis of the mesenteric veins, or the iliac veins; or it may open spontaneously into some adjoining viscus and produce a permanent fistula between the appendix and a small intestine, or some other part of the colon, the rectum, the urinary bladder, or even the ureter itself; or, worst of all, the appendix itself, or a perityphlitic abscess, may rupture into the general peritoneal cavity and produce a sudden general and fatal peritonitis.

Mr. G., 34 years old, of strong build and ruddy complexion, was an architect's overseer. He had never suffered of any serious disease except an epididymitis, which had necessitated the removal of his right testicle. The history of the case would indicate that it was a gonorrheal, or perhaps a tuberculous epididymitis, in an otherwise perfectly healthy man. He was

a good eater and a moderate drinker. He had never suffered of any noticeable abdominal disturbance or disease. He had been troubled with a moderate constipation, and had been accustomed to use patent medicines of a laxative nature. One day, on alighting from a railway train, he felt a severe pain in his lower right inguinal region. The pain extended in the course of a few seconds over the whole abdomen, and produced a feeling of faintness and nausea. He sat down on the station platform and asked some passer-by for assistance. He received a small drink of whiskey, and felt better. In a few minutes he was able to rise and walk half a block to his house. The faintness and abdominal distress continued. He went to bed, and had hot fomentations applied to his abdomen. He vomited two or three times during the evening, and late at night called a physician. The physician found a very rapid pulse, 120 to 130, and subnormal temperature, and the patient in a state of collapse, with cold sweat and anxious expression, and greatly distended abdomen. The whole abdomen was excessively tender on pressure. He administered a large dose of morphine, and the patient somewhat recovered and went to sleep. The next morning his pulse was still above 120, his temperature had risen to 104; the abdomen was excessively distended, and the man had become slightly jaundiced. He suffered excruciating pains, he vomited almost constantly, and had been unable during the whole night to pass either urine, fecal matter, or flatus. At this time I was called to see him, and in view of the symptoms and findings above narrated, I made a diagnosis of a ruptured appendix, or a strangulated retroperitoneal hernia, producing obstruction of the bowels and general peritonitis. I recommended operation. The patient consented, and an hour later I opened the abdomen in his own house, and found a general suppurative peritonitis. The appendix lay in the base of the wound; it contained three large fecal concretions, each of which was the size of a hazelnut. One of these concretions obstructed an opening between the appendix and the general peritoneal cavity, and was readily squeezed out of the opening upon first grasping the appendix. The appendix was removed, and the whole pelvic and peritoneal cavities drained with enormous quantities of iodoform gauze. The patient seemed

to recover after the operation, but died in forty-eight hours with all the symptoms of general peritonitis.

Here was a case of appendicitis which had been entirely unrecognized by the patient. His first symptom was probably the result of a rupture of the appendix, which had been thinned down to a parchment-like consistency directly over one of the fecal concretions. The rupture was produced by sudden twisting, or sudden pressure upon the appendix, the result of jumping from a train upon a solid plank platform two or three feet below. Had he called a physician at the time of the injury, and had the physician been wise enough to recognize the gravity of his symptoms, and had he insisted upon and secured an immediate opening of the abdomen, removal of the appendix and drainage, it is probable that the patient's life could have been saved.

To illustrate the uncertainty which surrounds the prognosis in any case of appendicitis, another instance which occurred on the same railway platform may be cited.

One summer's day in 1897 I met, in the railway station, a very promising and well-known barytone. He was about to take a train for the city. He expressed his delight at seeing me, and told me that he had been suffering for a couple of hours with a terrible pain in the lower part of his abdomen. I questioned him carefully, and found the symptoms of an acute appendicitis. I urged him to return at once to his home and go to bed, promising to visit him within two hours and make an examination. I tried to impress him with the gravity of his symptoms. He acceded to my request, and when I returned two hours later I found him in my office. He assured me that he was entirely relieved, and that he had never felt better in his life. He refused any further

examination. The November following I was called to see the same patient. He was then in the Chicago Baptist Hospital. On the previous Sunday he had been taken with a similar pain while singing in a neighboring church. He was obliged to stop in the midst of a solo, and was taken to his home in a carriage. He suffered of terrible abdominal pain for two or three hours, until he was relieved by the administration of several hypodermics of morphine. He remained in bed, suffering somewhat of abdominal distress, for four days. During this time he was unable to eat; he was obstinately constipated; he had received a number of doses of morphine, and several other sorts of medicine from his attending physician. Thursday night he received some sort of cathartic, and early Friday morning he felt that he must have a movement of the bowels, and walked a short distance to a water-closet. On his way he had an excruciating abdominal pain, followed by faintness and collapse. He was found upon the stool, where he had fainted. He was taken to his bed, his physician was called, and early in the morning he was brought to the Chicago Baptist Hospital. When I examined him I found the evidences of a general peritonitis. The pulse was 120, the temperature 104, the abdomen distended; he vomited fecal matter, he had an anxious and septic look, his urine contained albumin and a few casts, and by rectal examination the pelvis appeared full and edematous. The patient told me he had called another physician on Sunday, because he was afraid that I would recommend an operation. Now he wished to have my advice before he was operated on by his physician. I assured him that his condition was very serious, and that there was absolutely no doubt as to the necessity of an immediate operation, and said that I would administer the anesthetic myself. I administered the chloroform; the abdomen was opened, and a lake of pus was discovered filling the whole pelvis, and so far as known, the general peritoneal cavity. Sponges were packed in around the appendix, the appendix skilfully removed, and the peritoneal cavity drained with an abundant tampon of iodoform and ordinary gauze. The patient seemed to recover after the operation; his appearance and pulse and temperature became better, and he was able to see his mother; but he died at the

end of forty-eight hours of general septic peritonitis. The post-mortem showed a most terribly extensive peritonitis, reaching to nearly every part of the abdominal cavity; the loops of intestine were covered with a grayish white, fibrinous exudate. There was an acute septic nephritis and hepatitis.

This experience confirmed me, more than all my previous reading and reasoning, in the belief that the symptoms of an appendicitis offer no suggestion as to the favorable or unfavorable termination of the attack. From this day on I decided that no case of appendicitis could present such a history as would induce me to recommend any sort of medicinal or expectant treatment.

Acute appendicitis is a very misleading term. The most acute cases gradually verge downward into the most chronic cases without any line of demarcation. Some cases are so free from pain, and are so devoid of objective symptoms, that they appear to be cases of typhoid fever with a more or less irregular course and septic temperature. They are usually of shorter duration than typhoid, two or three weeks long, and sometimes only a week in duration. The Widal reaction never appears, or if present at all, it is probably due to a previously acquired immunity. In some few cases appendicitis appears with a sharp, pronounced attack and the patient suffers at the same time of typhoid fever. In my experience there has been only one case of this kind, in which I removed a distended, obstructed, suppurating appendix from a young man, whose subsequent course proved that the operation was performed on the third day of a typical typhoid fever.

Chronic and irregular appendicitis present so many manifestations that it is difficult to say what the subsequent course of any case may be. It will be seen by referring to the case of Mr. B., Chapter III., page 64, that a chronic appendicitis may suddenly terminate in rupture and a fatal general peritonitis. This is not at all an unusual event. Many cases of so-called acute appendicitis are simply acute attacks occurring in the course of a chronic appendicitis. It would almost appear that the appendix is in a state of chronic disease in a large portion of civilized humanity; that the natural tendency of the appendix is toward an obliteration of its lumen, and a disappearance of its mucous membrane. When a case of chronic appendicitis has been recognized, however, one cannot state that it is likely to go on to a complete obliteration of the lumen. At any moment it may give rise to the most acute and painful symptoms, and to the gravest conditions. On two occasions I have opened the abdomen for painful but afebrile symptoms and found nothing but an almost completely obliterated appendix. In both of these cases, after removal of the appendix, the symptoms entirely disappeared, and the patients, who had previously suffered of such agonizing pain and nausea as to result in the loss of weight and relative starvation, became perfectly well and sound and their abdominal distress, nausea, and dyspepsia disappeared. It seems hardly likely that these recoveries were due to the administration of the anesthetic, the few days of absolute starvation and complete rest of the stomach, the operation leucocytosis, and the change of

food; but it must be admitted that an error might arise in this connection.

Until we have some more positive means of recognizing the condition of the appendix before a laparotomy is made, it will be impossible to make any prognosis in regard to the course and termination of appendicitis. Only the opinions of students and observers can now be collected. In a general way these opinions have shown, with more and more positiveness as years go on, the gravity and fatality of acute and chronic appendicitis. If the infection of the mastoid antrum is a charge of dynamite at the base of the skull, the infected and deformed appendix is a similar charge in the abdominal cavity. Acute appendicitis terminates fatally, or produces almost fatal results, in a very large per cent of all cases. Few authors suggest less than 5 per cent, and many authors suggest more than 20 per cent. The fatalities from acute appendicitis occur at any time from the end of the first day to the end of the eighth or tenth day, when the greatest number of deaths occur, and from this point on to months and years. In 1892 I operated upon a woman 35 years old, who had suffered for twenty years of an appendicitis, with fistulas in the rectum, in the vagina, and at last through the abdominal wall. In 1887 I presented a specimen before the Chicago Gynecological Society of a pyonephrosis which originated more than ten years previously after an attack of appendicitis. The appendix communicated with the right ureter, and its tip opened into the upper portion of the rectum. The pus from the kid-

ney passed down the right ureter, and through a portion of the appendix, and into the rectum. Fecal matter had frequently been passed by the patient through the urethra.

Recurrence is said to follow recovery from attacks of appendicitis in at least one-third of all cases. My own experience, and the study of the pathologic specimens at my command, lead me to think that the appendix is rarely left in a normal condition after a single attack, and that each attack renders a subsequent attack more and more certain. If we take into consideration the immediate mortality from acute appendicitis, the duration of each attack, the tendency to recurrence, and the danger in each recurrence, we find that appendicitis is a most serious and perilous disease.

The course of appendicitis is absolutely unmodified, or at least it is not at all ameliorated or improved by any sort of medicinal, dietetic, or therapeutic measures. Each of these procedures has its advocates, and each is attended by added danger to the patient. The opium treatment of our forefathers, the starvation, lavage, and enemas of modern empirics, and the equally irrational and transient fads of the osteopath and Christian Scientist add alike to the suffering of the patient, and each introduces new dangers and risks. The only possible excuse for any of them is the absolute physical impossibility of an immediate, rational, skilful surgical treatment.

If the patient is far removed from a physician or surgeon competent to open the abdomen, then and only then may he be treated by absolute rest and star-

vation. Lavage of the stomach and irrigation of the colon are equally productive of peristaltic action, and if peristaltic action is to be avoided they should not be practiced. When it is necessary for the patient to wait for the uncertain efforts of nature, no promise as to the result, and no attempt to guide the course of repair, should be assumed by any one of intelligence and pathologic understanding. The patient is like a child cast adrift in a canoe to ride a dangerous cataract; the lookers-on are helpless with their incantations and their feeble attempts to stem the torrent or determine his course.

The medical and dietetic treatment of chronic appendicitis is almost as helpless, though perhaps not so risky, as that of acute appendicitis. It is a fact that by restricting the diet, by semi-starvation, and by limiting the activity of the patient, the course of a chronic appendicitis may be considerably modified, and the patient rendered much more comfortable; but this is not a cure, and the dangers of a sudden recurrence are not materially changed. Even after years of dietetic and medicinal amelioration of disease of the appendix, a sudden acute attack is liable to terminate fatally, as in the case reported on page 64. The adhesions about the appendix, the obstruction which results from peristaltic action, the liability to volvulus, incarceration, and intussusception, are some very real dangers of a chronic disease of the appendix.

With a thorough understanding of the pathology of appendicitis, and of its course, dangers, duration, and tendency to recur, the indications for treatment are

simple. They may be expressed in a word. The appendix should be removed and the removal should be done at once. The more acute the attack, the more immediate should be the operation. There is no condition, from the time that the disease is relatively and exclusively diagnosed to the last expiring breath of the patient, in which an immediate operation is not indicated. The only exception to this rule which has ever been sustained by a grain of argument is that of refraining when the patient is moribund. Theoretically this can be granted, but who is wise enough to say when a patient is ripe for dissolution? The physician or surgeon has no right to fear for anything except his own mental integrity, and he should never be afraid to proceed with a rational treatment, however much its result might tend to his own confusion, provided it offered one single hope for the life and health of his patient. Every operator has unexpectedly found conditions which seemed to preclude the possibility of recovery, and yet after the removal of the primary focus of infection, and the drainage of the abdomen, marvelous recoveries have taken place. Such experiences intensify the significance of the adage that there is hope as long as there is life, and no surgeon has the right, however great his wisdom, to deny his patient this last hope.

The only factor which can have any influence upon the proper procedure is the experience and surgical fitness of the operator. Dr. J. B. Herrick has said that every case of appendicitis should be operated upon as soon as it is diagnosed providing the operator has that technical skill which is necessary to cope with

the most difficult case which could be met. Without that skill he asserts that the expectant treatment is perhaps more favorable, and therefore warranted. This opinion from so conservative a physician conveys two important lessons. The first is the absolute impotency of any medicinal treatment, and the second is that the character of the disease cannot be predicated by any examination or study of the symptoms. Every medical community possesses, and ought to encourage, at least one or two men who have the natural qualifications, the training, and the skill to treat appendicitis properly.

Thirty years ago puerperal sepsis was discussed in every medical society, and many methods of treatment were lauded or condemned in rapid succession. To-day there is no method of treating puerperal sepsis discussed. This disastrous event is looked upon as compromising to the obstetrician, and preventive measures alone receive attention in medical schools and medical societies.

The complications which are the natural course of neglected appendicitis will soon be looked upon as requiring an apology from the attending physician or surgeon. Only under exceptional circumstances and in rare instances do the catastrophies of appendicitis appear without adequate warning. The more frequently the physician has suffered these catastrophies to overtake his patients, the more conscientiously has he considered his own relations to the case and his possible neglect of warning or his turpitude of indecision, and the more sensitive he becomes to the diagnostic symptoms, and the more promptly he acts in

securing a rational treatment. The ex-cathedra dicta of certain of the present leaders of our profession have poisoned the minds of many a conscientious doctor with the pseudo-scientific nostrum of delay. The starvation-lavage-enema treatment has cost the country more in invalidism, and resulted in more fatalities since its promulgation than the Spanish-American war.

The natural course of appendicitis is onward, progressive, and destructive. There is no safety in rest, starvation, and delay, but the gravest dangers of uncontrollable and irremediable disaster. Among these disasters the most common and the most remediable is the formation of a perityphlitic abscess. This condition is spoken of as if it were a benign and favorable event. It is, however, fraught with the gravest and the most uncertain danger to the patient. The abscess may form about the appendix in such a way as to result in edema of the ileocolic mesentery, obliteration by thrombosis of the ileocolic branches of the portal vein, and the grave consequences of necrosis of the colon or ileum, infected embolism in the liver, the lung, or other parts of the body. It may form in the retrocecal or retrocolic fossa and eventuate in a subphrenic abscess; or after perforation of the diaphragm in suppurative pleuritis, gangrene of the lung, and discharge through the bronchi. It may be so located in the pelvis as to follow the cord through the inguinal canal, or follow the large blood-vessels through the femoral ring, and first show itself as a fluctuating tumor in the subcutaneous tissues about the knee. It may surround the ureter with edematous and infected connective tissue and result either in an acute obstruc-

tion of urine in the right kidney, or should the patient fortunately survive, in valve formation in the ureter, hydronephrosis, pyonephrosis, and the succeeding sepsis. It may come in contact with an ovarian or other pelvic tumor and produce necrosis and infection, with extension to the pelvic connective tissue and presentation in the rectum or vagina. It may result in immediate obstruction of the bowels or such deformity as to result in adhesions and later in volvulus, internal hernia, or, in children, intussusception. It may, so much hoped for event, open into a gut or through the abdominal wall and perhaps leave a fecal fistula.

The following case by Brittin, American Medicine, September 19, 1903, illustrates the viciousness of delay and the possibilities of trouble even under careful surgical treatment:

"J. N., a young farmer, aged 38, German-American, presented himself at my office, June 23d, with the following symptoms: Patient anemic, body poorly nourished, tall and very spare build, complained of violent pain existing four days in right lower quadrant of abdomen, not specially localized but severe in character. He had been vomiting, and his pulse was 80 and his temperature 98°; urine normal. He had ridden to my office from his home six miles in the country, making the journey alone in a buggy. I expressed the belief to him that his was a case of appendicitis, and recommended him to return home and take to his bed, which he proceeded to do. I instituted the Ochsner treatment at once, but the patient's condition not improving on the afternoon of the second day after his coming under my charge, I strongly insisted on operation, as the symptoms at that time pointed to rupture of the appendix. Twenty-four hours after his coming under my observation the abdominal symptoms seemed to indicate the McBurney point as being the seat of the trouble. The bowels remained constipated, and vomiting was

intense. On the afternoon of the second day the pain suddenly stopped and the tenderness became more diffused. The patient subjectively seemed better, the pulse being about 70, but the temperature subnormal. I made diagnosis of rupture of the appendix, and urged immediate operation. Surgical consultation was called, and although the hour was late and the surroundings for an abdominal section were not ideal, yet we proceeded by the dim light of a kerosene lamp to operate. The incision was followed by the evacuation of pus which seemed to be free in the abdominal cavity. A very highly inflamed and gangrenous appendix was found, which had ruptured close to its attachment to the cecum, the rupture including two-thirds of the circumference of the appendix. Fecal concretions were found floating in the pus in the abdomen, which was I believe the foulest smelling pus which I have ever encountered. The operation was completed as quickly as possible, and the patient put to bed in a state of profound collapse, from which he gradually rallied, and the case pursued the usual course until July 19th, on which date he had a severe chill, or rather a succession of rigors, with pain in left lower extremity from the groin to the foot, most marked over the course of the saphenous vein. The extremity became very much swollen and congested, very painful, especially on motion. The temperature reached 103°, with corresponding pulse rate. The patient lost appetite, and the outlook was gloomy. The abdominal wound was still discharging pus, though not in large amount. The leg was enveloped in cotton and lightly bandaged and elevated, and the patient was put on tincture ferric chlorid, digitalis, and strychnia, with brandy given freely. This condition of affairs persisted without noteworthy change for two weeks, when there were signs of improvement noted, and convalescence now seemed fairly well established, with considerable edema of left lower extremity still persisting. September 1st, patient had so far recovered as to be able to ride in a buggy from his home to my office. Left lower extremity still edematous."

It is almost impossible to pick up a medical journal without finding some warning against delay in

treating appendicitis, but no instance of that kind is more suggestive than the following case, reported by Nathaniel P. Dandridge (Gangrene of Colon and Ileum after Operation for Appendicitis, Annals of Surgery, September, 1903). This case is a warning from almost every point of view. The patient had already suffered eight attacks of varying severity, and doubtless he had had intervals during which he gave symptoms which would be a sufficient indication for appendicectomy to any except the most hardened and luck-trusting practitioner. Even after a surgeon was called and abundant evidence of the disease made out, he decided to wait until all fever had subsided and then, after a few days, operate. When the incision was made the mesenteric bubo was mistaken for a tuberculous lymph gland, and in its removal a branch of the ileocolic artery was injured and ligated. By a piece of most remarkable good luck the integrity of the gangrenous gut lasted long enough to permit the walling off of the general peritoneal cavity and the subsequent discharge of half a yard of intestine through the abdominal wound. Either as a result of this primary infection, or as a result of some antecedent attack of appendicitis, or the suppuration which followed an attempt at a lateral anastomosis, an infection of one of the calicies of the left kidney occurred, and to the already grave disease a pyonephrosis was added. The patient is left then with a troublesome fecal fistula and a dangerous pyonephrosis, liable at any time to end his life or subject him to another serious and mutilating operation.

"March 25, 1901, I was asked by Dr. Joseph Eichberg to see L. B., aged 26 years, who was suffering from an attack of appendicitis. Within two years he had had eight attacks of varying severity; none, however, requiring rest in bed for more than a day or two. The present attack had commenced some ten days before; the symptoms, mild in character, had been persistent, but at the time first seen had come to a standstill, and, indeed, seemed to be on the decline. There was a marked tumor in the right side in the region of the appendix. The outline towards the median line could be well defined; above, below, and to the outer side the limits were not so well marked. The tumor was not very sensitive to pressure, though rigidity of the abdominal wall was present. The temperature was 101.4°F., and the pulse but slightly above normal. As the symptoms seemed to indicate improvement, it was decided to wait until all fever had subsided, and then operate. After a few days, however, fever and pulse both increased, and it was decided to operate at once. This was done March 31st. The incision was made at the outer edge of the rectus muscle. Opening the cavity, the appendix could not be found. We came, however, on the mass which gave rise to the tumor found at the first examination, on the inner side of the colon and above the ileocecal valve. This was beneath the peritoneum, bound down to the psoas muscle, and overlapping its inner edge. It was thought to be a mass of exudation about the appendix, and I at once proceeded to enucleate it with the finger. When partly separated, a vessel of some size was seen to penetrate and pass through it, so that the pulse could not be felt beyond. It was necessary, therefore, to ligate the vessel

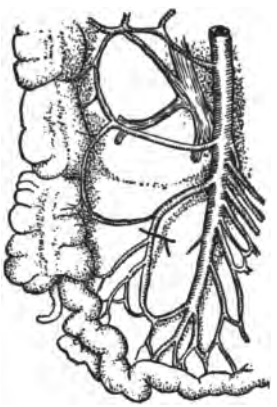

Fig. 27. Diagram of the arterial supply of the ileocecal region The gamma shows the probable site of injury of the ileocolic artery in removing the enlarged lymph gland.

before removal was completed. The parts removed proved to be some enlarged glands about the size of a hen's egg. They appeared to belong to the iliac chain of lymphatics, and were presumed to be tuberculous. This view, however, was not sustained by the subsequent microscopic examination, and they were doubtless mesenteric glands. The appendix was subsequently found behind the cecum. It was three inches in length, reddened, thickened, and club-shaped. The tip was enlarged. There were no adhesions. No pus was found.

"The cavity made by the removal of the glands was then mopped out, and as no pus had been seen, and the peritoneum everywhere appeared normal, the wound was sewed up without drainage. The operation was made under ether. On the morning of the third day a dose of castor oil was given, and this was followed later by a salt and glycerin enema. Vomiting occurred from time to time during the day, and bowels moved at 10 P. M. Temperature had once reached 101 F. During the next few days there was some vomiting and a good deal of nausea. The bowels moved naturally and freely. The temperature became normal, and the pulse ranged from 64 to 70. On the morning of the seventh day some of the stitches were removed, and the wound found healed by first intention throughout. The nausea had disappeared, and the only discomfort complained of was a dragging sensation in the right side when he turned over on the left. On the morning of the eighth day the condition was so favorable that I announced that my daily visit would be discontinued. That evening he complained of severe pain in right side, and in the middle of the night the dressings were found saturated with a thin fecal discharge from wound. When seen the next morning the fresh dressings were again saturated, and gas and thin fecal fluid were found escaping from the upper extremity of the incision; the rest appeared firmly united. All the remaining stitches were removed, the lips of the upper part of the wound for an inch were separated, and then at once presented a small bit of sloughing membrane. By night the wound had opened throughout its entire extent, and a portion of gangrenous bowel, apparently the colon, and some two or three inches in extent, was hanging out. The temperature rose

to 101.4 F., but soon reached normal again; the pulse never went above 88.

"The next day the projecting mass of sloughing intestine was sundered with scissors; it came from the colon, but did not involve the entire circumference. The pouch removed contained light brown feces. The next day a further portion of sloughing intestine had escaped from the wound, and was likewise removed; and a day or two afterwards a piece of small intestine nine inches long was washed out of the wound. During this time fluid or mushy feces was continually escaping from the side, the wound having gaped wide open. There was persistent nausea, and koumiss was the only nourishment retained. The temperature was about normal, the pulse was above 90. The urine was voided in full quantity—usually voluntarily; but at times the catheter was used. The opening in the bowel at this time could not be seen. From the pieces removed, it was estimated that fifteen inches of small intestine and cecum had sloughed away. A rise in temperature after a few days occurred, and was followed by the escape of pus from the upper and outer side of the wound; the feces came from the lower part. From time to time a rise of temperature occurred with the escape of pus. This continued for some days, when a drainage tube was inserted into a small abscess cavity. Drainage being secured, the discharge of pus ceased, and with it the temperature. On April 14th an enema was given, and some scybalous feces removed. Subsequent enemas partly escaped through the wound, and were partly returned, but no fecal discharge secured. The wound soon took on a healthy action, and filled up and contracted, and after a time the opening in the small intestine from where the feces escaped could be identified, and the further contraction of wound brought it nearer the surface. The character of the discharge would vary, acrid discharge would excoriate the surrounding skin, then there would be simply mushy brown stools, and occasionally curds of milk. For days milk was the principal diet, and for a time there was a progressive emaciation, which, however, passed away on a more liberal diet. Bismuth, magnesia, and some form of opium had to be resorted to to restrain the action when the discharge became thin. The discharge of feces would occur without the

patient's knowledge, and the dressings were changed about four to six times daily.

"Thus things continued—the wound granulating and contracting; there was evident improvement in nutrition; a varied diet was allowed, and the character of the discharge indicated a satisfactory digestion.

"As the condition seemed favorable, it was determined to try and relieve the artificial anus by operation. After full consideration, it was determined to establish a connection by lateral anastomosis between the small intestine and sigmoid flexure, in the hopes that the greater part of the feces would be diverted, and that subsequently the artificial anus could be dealt with more safely. The patient was prepared, and the operation was made May 19th, forty-nine days after the first.

"The old wound was first flushed out, and then sewed up tight, so as to prevent any contamination by escaping feces. An incision was then made half an inch to the left of the median line, and the cavity opened through the rectus muscle. The right side of the abdomen was found well walled off, the rest free of adhesions. The small intestine leading down to the adherent part was somewhat thickened and reddened. It was found difficult to draw up the sigmoid flexure sufficiently on account of a short mesentery, and it was decided, therefore, to make the anastomosis to the transverse colon. This was drawn down, and a point selected as far away from the opening in the ascending colon as possible. The point selected for the anastomosis in the small intestine was eighteen inches from the adhesion in the right iliac fossa. The anastomosis was made with the O'Hara forceps, and the approximation readily accomplished. The loop of intestine leading to the anastomosis was then brought together by some stitches in order to secure sharp angulation at the opening as an extra precaution against the passage of the fecal current beyond the opening in the colon. The abdominal wound was closed without drainage, and the original wound reopened.

"It was hoped that the lateral anastomosis would carry off the greater part of the fecal current, if not all. The sequel shows that this hope was not well founded. The day following there was some greenish vomiting, and on changing the dressing

over the old wound some mucus and a little pus escaped, and the next day some thin feces. On the fourth day an enema was given and retained; later the dressing in the side was found saturated with water stained with feces. On the fifth day a glycerin suppository was inserted at 7 A. M., and again at 6 P. M.; the next day gas was expelled from the rectus, and the bowels moved, the motion consisting of small masses of fecal matter and mucus. The abdominal pain which had been complained of ceased. The temperature reached 100 F., but most of the time was normal. Enemas brought away small amounts of feces, the discharge from the artificial anus being nearly as free as ever. May 29th the stitches were removed from the median incision; the next day some foul pus escaped from a stitch opening. This continued to discharge for some days with an increase of temperature. The original wound continued to contract. The fecal discharges were from four to six daily. June 7th there was a motion by the rectum, and for several days there were well-formed stools by the natural channel. These, however, soon ceased. For some weeks enemas would bring away some fecal matter, but were finally returned unchanged. The lateral anastomosis was, therefore, a complete failure so far as relieving the artificial anus was concerned. Matters remained unchanged during the summer. The general health of the patient improved. Nutrition was good, and a number of pounds in weight gained. Some time in August the patient passed a small phosphatic calculus by the urethra, and some pus cells were found in the urine. Subsequently several other masses were voided. From time to time pain and swelling in the left side with fever left no doubt of a calculous pyelitis.

"On returning from my summer vacation, it was determined to attempt the relief of the artificial anus by uniting the ileum and colon in an end-to-end anastomosis with a Murphy button. This was done October 8th—189 days after the first operation.

"The patient had gained a number of pounds of flesh during the summer; looked well; ate freely of whatever he desired, and the character of the stools indicated that it was well digested. The incision from the first operation had contracted to two inches. The opening of the small intestine from which the feces dis-

charged was raised above the level of the skin, and the mucous membrane everted. A vermicular movement of the mucous membrane always preceded the fecal escape. There were firm adhesions around the small intestine on all sides, except at the upper and outer end of the wound, from which oil injected by the rectum had escaped a few days before, showing that the opening led to the colon.

"Chloroform was administered, the patient being a long time in going under. The finger was introduced into the artificial anus, and penetrated about two and one-half inches, when it was blocked apparently by the intestine making a sharp bend. A Nelaton catheter stopped at the same point. The opening was first closed by stitches to prevent the escape of feces during the operation. The wound was now circumscribed by an incision in normal skin, and the abdomen was opened through the fibers of the rectus muscle. The transverse colon first came into view, and an attempt was made to inspect the site of the lateral anastomosis. This was unsuccessful owing to omental adhesions. The ascending colon was identified. The open end was fixed quite deeply, and freed with a good deal of trouble, and brought to the surface. It was found necessary to freely trim the ragged edges before the button could be adjusted, which was done with difficulty, owing to the varying thickness of the tissues. The small intestine was now freed from the adhesion about it. The bowel was thickened, and the peritoneal coat had disappeared from the adhesions. The everted mucous membrane was removed, and the button was adjusted with difficulty owing to the thickness of the tissues. The two sections were brought together without tension, and the line of union fortified by some stitches. Strips of iodoform gauze were placed on either side of the bowel, and the ends of the wound closed, except about two inches.

"The operation lasted two hours, and at the end a normal salt solution injection was given. The recovery from the anesthetic was fairly prompt, but was followed by a good deal of thirst and vomiting. On the third day the gauze was removed, and the same evening a grain of calomel was given, followed the next day by one-tenth grain hourly. Gas began passing by the rectum on the second day, and on the evening of the fifth day

there were two free stools at an interval of an hour and a half—dark colored, pasty, and offensive. On the morning of the sixth some fecal fluid stained the dressings, and a fistula was established. Regular discharges, however, were secured daily by glycerin suppositories, the amount escaping from the fistula varying with the condition of the bowels, averaging probably one-fifth of that by the rectum. The wound rapidly cicatrized until the opening was only large enough for a large-sized probe. Later, two attempts were made to close the fistula by operation, the only result being an increase in the amount of discharge for a time. In the mean time there was a serious attack of pyelitis. The temperature varied from 101 to 102 F. A pronounced swelling with pain on pressure occurred over the left kidney, while the urine was found free from pus. Then suddenly occurred a free discharge of pus with the urine, and a sudden cessation of all the symptoms, fever and swelling both disappearing. Since then, however, there has always been a trace of pus in the urine. Various colostomy pads were tried in January, 1902, and final closure of the opening secured by the pressure of a rubber sponge held in place by an elastic bandage around the waist. It is now over fifteen months since there has been any discharge, and the man has been for some time engaged in active business."

In 1886 Dr. Christian Fenger had a patient upon whom he had operated several times for inguinal abscess, which he presumed to be due to a chancroidal bubo. The chancroid had long since gone away. With his usual thoroughness he had extirpated the inguinal lymph glands, but suppuration persisted at the bottom of the wound, and after months and months of treatment, and a series of extensive operations and dissections, a few particles of fecal matter at last appeared in the wound, and suggested its connection with the intestinal tract. A last operation was undertaken, and with an entirely extraperitoneal dissection

the appendix was removed, and the wound closed rapidly and permanently.

In 1892 a patient was brought to me by Dr. Carlson for an operation upon a right inguinal bubo, which had persisted for nearly three months. During the preceding six months the patient had been invalided by recurring attacks of abdominal pain, vomiting, and fever. The diagnosis of appendicitis with infection of the abdominal wall and apparent superficial lymphangitis was made and confirmed by an extraperitoneal appendicectomy. All the tissues in this case were enormously thickened and hypertrophied or infiltrated, and sections and cultures showed the neoplasm-like mass invaded with the colon bacillus. Had it not been for previous experience, I should have looked upon this new growth as malignant.

A most remarkable case came under my observation in 1894. The patient was a vigorous young man of 28 or 30 years, who had complained of lameness for several weeks with pain in the right knee and hip. During three weeks he had been confined to his bed with chills, pain in the abdomen, vomiting, occasional tympanites, and constipation. He had been treated with large doses of morphine. I was called because the attending physician thought he had a suppurating knee joint. When I examined him I found the skin over his whole body dry, scarf-like, and dirty. It was evident that he had not had a bath for days or weeks. His face and tongue, and the mild delirium which he showed, spoke for a profound intoxication. His abdomen was only moderately distended, but the right pelvis and the right side of his abdomen was filled

with a firm, fluctuating tumor. The right leg was edematous, and about the right knee was a large superficial fluctuating tumor. It was evident that the knee joint was not involved, and that the tumor was subcutaneous. Slow and protracted pressure upon the abdominal tumor increased the size and tension of the tumor about the knee. I made a diagnosis of chronic appendicitis, with a large perityphlitic abscess, probably following the large blood-vessels into the leg, and presenting itself at the knee. Exploratory puncture gave a negative result. After careful washing of the skin, and without any anesthetic, an incision four inches long was made over the inner border of the patella, and a pint or more of dark pus, containing bits of fecal matter, and having a decided fecal odor, ran out. The finger discovered a sinus leading upward toward the pelvis. Pressure upon the pelvic tumor caused a similar pus to pour out of the sinus. A few whiffs of chloroform were now given the patient, and a careful dissection over the crest of the ilium was made into the fluctuating tumor. More than a pint of feculent pus was evacuated. The abscess cavity was washed out, and the sinus between the knee and the pelvis irrigated with hot antiseptic solution. Both abscess cavities were packed with gauze. The appendix was not discovered. The patient was in a profuse sweat when the operation ended, and he died within forty-eight hours with all the symptoms of sepsis. At the autopsy the greatly hypertrophied appendix was found communicating directly with the pelvic abscess cavity.

In January, 1900, Dr. Robert H. Babcock was

called to see Mr. B., 22 years old, on account of supposed tuberculosis of the lung, for which his attending physician proposed to send him to New Mexico. Dr. Babcock at once discovered a greatly emaciated young man, expectorating very offensive and fecal-smelling pus. The whole right side of his chest was tympanitic or flat, and the patient was unable to lie down, and scarcely able to sleep, on account of violent coughing spells. He at once made a diagnosis of empyema, and on account of the history suggested abdominal and probably appendiceal origin. I saw him the next morning at Dr. Babcock's suggestion. The examination was brief on account of the sickening odor of his breath and the superheated room in which he was sitting. The patient was taken sick with all the symptoms of appendicitis on September 12, 1899. He remained in bed for ten days, and had great distention of the abdomen, frequent vomiting, and was treated for inflammation of the bowels. On the eleventh day he sat up, he stopped vomiting, and became moderately jaundiced. During the following month he remained away from work, and had a hacking cough, with pain in his back and right shoulder. Full inspirations were painful. He occasionally had slight chills, and he had sweats every night. During this time he lost weight, his appetite was irregular and perverse. On the 20th of November he went to work. He was not feeling well, and the heavy sample case which he carried troubled him. On December 6th he had a terrible pain in his right chest on alighting from a street car, and within an hour he was in a terrible rigor. He was taken home and put to bed. His phy-

sician made a diagnosis of pleurisy the first few days, and afterwards pronounced the case one of pneumonia. The patient continued to grow worse, had very high temperature all day long, very short breath, absolute loss of appetite, and frequent dry, ineffectual cough. The last of December he had a violent coughing spell, and spit up blood and pus. Since that time he had constantly expectorated pus, sometimes as much as a pint in two hours. The pus was dark, fetid, and fecal smelling. At my examination his temperature was 104, his pulse 130; he was sitting erect, as he had been for several days, and the slightest examination of the chest or abdomen provoked violent fits of coughing, with fetid, purulent expectoration. The upper part of the right chest was tympanitic, the lower part dull and silent. I removed him to the hospital in a carriage, set him up on an operating table, prepared the chest wall, infiltrated the skin over the fifth rib in the axillary line for a distance of four inches, incised the skin, separated the rib from the thickened pleura, and removed three inches and a half of it. There was little hemorrhage, and no discharge of pus. I then incised the pleura, which was not less than three-quarters of an inch thick, and removed a pint or more of fetid pus. During the following two weeks he gained a pound a day, and became very vigorous, and contracted gonorrhea for the first time. During the following three years his chest completely closed for periods of more than two months at a time at least three times, then he would have a gradually increasing temperature, a pain in his chest, and it would be necessary to open the pleural cavity again, resect a rib

or two, and drain an abscess, sometimes containing as much as half a pint. Repeated examinations of the pus from this empyema and these abscesses at the Columbus Laboratory showed the presence of the colon bacillus. On this account I determined at the last operation to remove the appendix at the same time. This operation was done in the spring of 1903. The appendix was long and sclerosed, but wholly free in the peritoneal cavity, and. no evidence of a subphrenic abscess was sought for through the small incision. A careful scraping out of the abscess in the pleural cavity was done, and another rib resected, so as to allow complete collapse. The patient recovered promptly, and has been entirely well ever since.

The history of this case and its course and bacteriologic finding speak very strongly for a subphrenic abscess of appendiceal origin, with subsequent empyema, gangrene of the lung, and at last obliteration of the abscess and the pleural cavity.

CHAPTER VI

DIAGNOSIS AND DIFFERENTIAL DIAGNOSIS OF APPENDICITIS

The responsibility of the diagnostician; the diagnosis of appendicitis always relative; the importance of the history of the case. Inspection of the patient; palpation; percussion; auscultation; exploratory puncture; exploratory laparotomy; the laboratory examination. Differential diagnosis; possible methods of classification; the clinical method. When the patient is a child; acute dilation of the stomach; intussusception; tuberculous peritonitis; gastrointestinal infection; pneumonia; calculi in the kidney or ureter; tuberculosis of the dorsal vertebræ; infection of Meckel's diverticulum and the urachus; sarcoma of the mesentery; cystic tumors of the kidney; hernia; distention of the urinary bladder; foreign bodies in the intestinal tract. When the patient is a young adult; cholecystitis; mucous colitis; ulcer of the stomach; typhoid fever; tuberculous peritonitis and miliary tuberculosis; acute pancreatitis; calculus in the ureter; incarcerated hernia; gastritis; gastrodynia; gastrointestinal catarrh; hysteria; malingering; undescended right testicle and gonorrheal orchitis; embolism of the superior mesenteric artery and gangrene of the intestine; uremia. When the patient is a young adult female; ruptured extrauterine pregnancy; abortion; pyosalpinx; prolapse of the ovary; ovarian tumor with

twisted pedicle; tort of the ureter of a floating kidney. When the patient is an old adult; carcinoma of the cecum; carcinoma elsewhere in the abdomen; prostatic perivesicle abscess; impaction of feces.

In making a diagnosis the surgeon especially occupies a very grave and responsible position. He is advocate for each and every hypothetical condition; he is judge and jury on the law and evidence; he is at last the administrator of his own judgment. In court and forum a great many attorneys and judges are engaged in deciding the fate of a man or his material interests, but the medical man stands alone at the bedside and decides and executes these matters without publicity. Is it a wonder that many fail in courage or err in judgment?

The significance of the symptoms of appendicitis and the danger of complications which obscure the diagnosis and complicate treatment are sufficiently set forth in the preceding pages. The diagnosis of appendicitis is always relative. Until after exploratory laparotomy has discovered the appendix itself it is never absolute, and even under such circumstances the pathologic condition of the appendix may require large experience or microscopic study for its interpretation. The diagnosis, however, is as absolute as that of typhoid fever, measles, erysipelas, or even gonorrheal salpingitis, and it is based very largely upon the clinical picture and the probabilities of the disease.

The examination of the patient forms only a small part of the material upon which the diagnosis is based.

The greatest stress must be placed upon the history of the case. The history must be taken with discriminating fidelity and painstaking attention to every detail.

The examination of the patient rarely results in very marked or very absolute findings, yet taking everything which has been developed by the history into consideration, the examination develops such findings as makes the diagnosis more or less positive.

Inspection in cases of perityphlitic abscess may occasionally show a tumor over the location of the appendix. As the patient lies upon his back the abdominal wall protrudes slightly over the abscess. If the patient walks into the office with a perityphlitic abscess or a sharp attack of appendicitis, he frequently favors the right leg, or he walks in such a way as to prevent shock by a sudden movement of the body. In rare instances there is an enlargement of the lymph glands in the groin.

When peritonitis is present, the facial expression, the thoracic respirations, the flexed thighs and knees, and the distended, protected abdomen, and even the violent peristaltic movement of the intestines, are all evident and suggestive on inspection. If obstruction is present, peristalsis and reverse peristalsis, ending and beginning at the right iliac region, can be seen when the abdominal wall is flaccid. The photograph, Plate VII., was made from a case of general peritonitis from appendicitis. The lower or caudal portion of the abdomen was filled with pus. The intestines in the upper or cephalic portion of the abdomen were active with peristalsis ending in the right iliac region.

Sometimes the discoloration of the skin by blisters and hot applications speak for repeated attacks of abdominal pain. In foreigners, and peasant people especially, the scars of cups and leeches are frequently evidence of old and severe trouble. The duration of the disease is sometimes suggested by the condition of the skin over the sacrum, elbows, and occiput. In rare instances the presence of fluid in the peritoneal cavity can be recognized by the configuration of the flanks and the condition of the venous circulation. Actual edema over a perityphlitic abscess is most significant. Edema of the abdominal wall is sometimes found when the appendix has become attached ventrally without rupture of a perityphlitic abscess.

As a peculiar form of inspection the use of the X-rays must be noticed. It is serviceable in detecting the presence of calculi in the appendix, and in one instance of my own (page 81) it led to an error in diagnosis.

Transillumination with the bladder distended with fluid and the electric illuminating apparatus in the thoroughly emptied rectum or in the vagina is occasionally useful in differentiating pelvic tumors when appendicitis is suspected.

As a part of the inspection the reaction of the pupil, the co-ordination of the muscles of locomotion and equilibrium, together with the condition of the deep reflexes must be noticed in order to exclude disease of the central nervous system and the crises of locomotor ataxia.

Palpation of the abdomen is most diagnostic in chronic and even acute appendicitis. The palpation

should be carried on with the patient thoroughly relaxed and all clothing removed from the abdomen and hips. The head should be slightly raised, the arms by the side, the thighs and knees flexed to the most comfortable position, and the utmost composure and quiet maintained. Except in acute cases and at the first examination, the bowels should be thoroughly emptied with an adequate cathartic. The abdomen should be either perfectly dry, covered with talcum powder, or under some circumstances, with oil or cocoa butter. The hand should be warm and passed carefully yet firmly over the chest and abdomen in such a way as to discover the flaccidity or rigidity of the abdominal muscles. One of the most uniform and most marked findings in appendicitis is the rigidity of the right rectus and oblique muscles. This symptom can be brought out in many ways, and the findings confirmed by repeated trials. Too great pressure should not be used. At first the full palm of the hand should be used, first on one side, and then on the other side of the abdomen; next the palmar side of the first three fingers can be pressed over the rectus on one side and then on the other side; and last of all the tip of the index finger can be used in the same manner. By these methods the findings are confirmed. In much the same manner the abdomen is again examined for tenderness. The hand should be used first on one side and then slowly and gently on the other side until it is possible to say that the tenderness is greater on the right than on the left side of the linea alba. Next the tips of the fingers are used to determine the exact point of tenderness.

Slow, gentle, and careful pressure is made over the gall-bladder, over the tubes and ovaries, and over the ordinary site of the appendix. The amount of tenderness depends entirely on the condition of the appendix or the stage of the disease. It is excessive in acute appendicitis and in the first stages of a perityphlitic inflammation; it is uniform over the whole abdomen in general peritonitis. It sometimes covers extensive areas in diffuse peritonitis and in the early stages of acute appendicitis when the appendix begins to leak. The well-defined perityphlitic abscess can easily be marked out by the palpating hand, even when the patient has not been anesthetized, and under anesthetic a buried or adherent inflamed appendix can be readily made out. In a rapidly increasing proportion of cases of chronic appendicitis the appendix can be palpated and rolled under the finger in the helpful and unanesthetized patient.

There are many methods of eliciting the tenderness or palpating the appendix. Slow pressure upon the left side of the abdomen suddenly released produces pain in the region of the inflamed appendix. Extension of the flexed thighs and knees produces pain in the region of the appendix when there is a periappendicular peritonitis, and especially when the appendix is attached in the region of the psoas muscle. The presence of fluid in the abdomen in contradistinction to a solid tumor is sometimes demonstrated by palpation with percussion over the opposite side of the tumor mass. This percussion may be made with the opposing finger in the vagina or rectum. When the appendix is located in the region of the rectum or

gall-bladder, or when a periappendicular abscess fills the pelvis, palpation through the rectum and vagina are necessary and diagnostic, and should never be omitted. When the perityphlitic tumor has been outlined, and it is necessary to differentiate it from the distended gall-bladder, the inflation of the colon with air or water is sometimes useful. The palpation of the abdomen should be carried on by the bimanual method; the one hand being opposed in most instances to the other. Only under rare conditions should the palpation be considered complete before a careful vaginal and rectal examination has been made.

Percussion in appendicitis is useful only after the formation of a perityphlitic abscess or a diffuse or general peritonitis with effusion. It is significant when the abdomen is distended in peritonitis or obstruction of the bowel by a periappendicular inflammation.

Ausculation of the abdomen is of use in discovering the first friction sounds of a peritonitis about the appendix, gall-bladder, or a perforating gastric ulcer. When a perforation has occurred with the discharge of fluid and gas into the peritoneal cavity succussion sounds are occasionally heard. These sounds occur with the ordinary peristaltic movements of the bowels. When obstruction occurs as the result of a periappendicular peritonitis the violent peristalsis ending at the obstruction gives rise to a most violent gurgling sound, and sometimes to a whistling sound or bruit, which is quite significant.

Auscultatory percussion and the auscultation of the

transmitted sounds from a tuning fork is sometimes useful in determining the outline of a periappendicular tumor. It is more useful in separating contiguous solid masses.

Exploratory puncture is a measure which the modern surgeon has the hardihood rarely to undertake, and never except when the patient is on the table and ready for a laparotomy. It may, however, be necessary in unusual instances and when the demonstration of the presence of an abscess is required to establish the confidence of the patient or the patient's friends in the diagnosis. It is, however, a measure which must be looked upon as fraught with immeasurable and irremediable dangers.

Exploratory laparotomy is a measure which must be undertaken in instances where every other means of diagnosis has been proved indecisive and conditions exist which require correction in order to preserve the usefulness and health of the patient. When this procedure has been decided upon, a written statement of the complete inefficiency of all other means of diagnosis should constitute the indication for treatment, and it should be recorded upon the history sheet and plainly stated to the consulting physicians and assistants. It is a method too lightly undertaken by the novice and by the routine technologist.

No portion of the examination is more important than the study of the temperature, the pulse, the respirations, and the examination of the blood, the urine, and in many cases the stomach contents and feces. Outside of a rise of temperature, a corresponding increase in the rapidity of the pulse, and the pres-

ence of a leucocytosis and indicanuria, there are no positive signs of appendicitis. The examination is conducted largely to eliminate other possibilities. Each of these possibilities is considered in the differential diagnosis of the several diseases which it is necessary to exclude. The pulse in acute appendicitis follows the temperature, and thus speaks against typhoid; the respirations are not materially increased, and thus any suspicion of pneumonia would be allayed. The leucocytosis is generally above eight thousand, and increases from hour to hour, especially when the increasing rapidity of the pulse suggests peritonitis. Indicanuria is almost invariably present, and in uncomplicated cases it is the only pathologic finding outside of the increase in all the normal constituents of the urine. It is extremely important to demonstrate the absence of the malarial organism, the absence of the Widal reaction, the absence of albumin and casts in the urine, the absence of fat or mucus in the feces, and the absence of lead in the secretions and excretions.

DIFFERENTIAL DIAGNOSIS.

It is customary to assume that the patient suffers of one disease and one disease alone, and that the complexus of symptoms ought to be so interpreted that combined with the examination it makes a clear, distinct, and exclusive diagnosis. This, unfortunately, is not always the case. Many patients suffer of more than one disease, and these diseases may so intertwine their symptoms that it is almost impossible to unravel them. When we speak of making a differential diag-

nosis, however, we assume that the patient suffers of a single disease, and that the symptoms which are manifested, and the conditions which are discovered by examination, simulate those of another pathologic basis. Generally, however, it is only some prominent or leading symptom or combination of conspicuous symptoms that arouses the susoicion of two or more diseases at once.

There are many ways of grouping the diseases which may be mistaken for appendicitis and for which appendicitis may be mistaken. (1) The diagnostician may look upon those symptoms which make a diagnosis of suppurative disease, and in this way appendicitis may be mistaken for disease in the gall-bladder, in Meckel's diverticulum, in the kidney, in the Fallopian tube, or in the intestine itself. (2) He may look upon the disease as localized in the neighborhood of the appendix, and thus mistake appendicitis for a hernia into the retroperitoneal pouch, into the obturator foramen, into the inguinal ring, or into the abdominal wall; for carcinoma of the cecum in the old; for intussusception in the young; for volvulus, for an impacted enterolith, for lead colic, for milk-sickness, or for hematoma, abscess or tumor in the abdominal wall. (3) He may consider the pain or colic without due regard to related symptoms and findings, and thus mistake for appendicular colic ulcer of the stomach, acute pancreatitis, impacted gall-stone, a hernia in the foramen of Winslow, a crisis of locomotor ataxia, a beginning penumonia and pleurisy, the colic of tuberculous peritonitis, the colic of stone in the kidney or ureter, the pain produced by a torsion of the ureter of a floating

kidney, a hernia into the ileojejunal pouch, a hernia into the linea alba, an aneurysm of the aorta, a prolapse of the ovary, a ruptured ectopic pregnancy, an abortion, a gonorrheal orchitis in an undescended testicle, or a rupture of the urinary bladder.

But it is not by any of these methods that the clinician attempts the differentiation. He takes into consideration the age, sex, physical condition, and history of his patient, and seeks out the most probable sources of error, and excludes them one by one. If the patient is a child, he thinks of acute dilatation of the stomach, intussusception, tuberculous peritonitis, gastrointestinal infection, pneumonia and pleurisy, calculi in kidneys and ureters, tuberculosis of the dorsal vertebræ, infected Meckel's diverticulum, infected urachus, tumors of the mesentery. If the patient is an adult between 15 and 45, he thinks of cholecystitis and colitis; of ulcer of the stomach; of typhoid fever; of acute miliary tuberculosis; of acute pancreatitis; of calculus in the kidney or ureter; of the crises of locomotor ataxia; of incarcerated hernia in the inguinal ring, the obturator foramen, the linea alba, or one of the intraabdominal foramens; of the pain incident to adhesions about the gall-bladder or the appendix; of hematomas, abscesses, and tumors in the abdominal wall; of tuberculosis of the kidney; of acute gastritis; of hysteria or malingering; of gonorrhea in an undescended testicle.

If the young adult be a female, in addition to most of the diseases mentioned appendicitis may be mistaken for extrauterine pregnancy; for abortion; for pyosalpinx, especially in the right tube; for ovarian

or fibroid tumors with twisted pedicle; for prolapse of the ovary; for torsion of the ureter in a floating kidney.

If the patient is above 45, in addition to the diseases the possibilities of which he carries over from young adult life, the diagnostician must consider carcinoma of the stomach, carcinoma of the gall-bladder, carcinoma of the intestine, especially of the colon and cecum, perivesicle abscess in men, carcinoma of the uterus in women, impaction of feces and enteroliths.

In any particular case which suggests appendicitis, if the examiner is led to change his mind from day to day, diagnosing gastritis in the morning and typhoid fever in the evening, neuralgia of the stomach to-day and calculus of the kidney to-morrow, it is evident that the proper amount of study and the judicial consideration of symptoms has been neglected.

WHEN THE PATIENT IS A CHILD LESS THAN 15 YEARS OLD

The child has a severe bellyache. Is it due to appendicitis or to acute dilatation of the stomach?

It is due to acute dilatation of the stomach, because the child has been previously healthy and was kept away from its mother or from the bottle for a longer period than usual, and at the end of that time took a heavy meal. It was taken with a severe pain upon waking up an hour after this meal. Its temperature is normal, its pulse slightly accelerated, its respirations slow; it has cried violently and attempted to vomit, and there is a large tumor in the left upper

quadrant of the abdomen, corresponding to the distended stomach, which gives a splashing sound upon agitation.

The child has a severe bellyache. Is it due to appendicitis or to intussusception?

It is due to intussusception, because the child is spare, almost marasmic, and has been troubled with indigestion and diarrhea for weeks or months. The present crying spell came on suddenly, and was more agonizing than anything that the child ever suffered before. It was followed by or begun at a copious stool. Since that time the bowels have attempted to move and only mucus has been passed with tenesmus; and last of all there has been a scanty bloody discharge. The temperature is low, 99 to 100. The pulse is rapid, 112 to 130. The child appears to be in a state of shock, and has the Hippocratic and ominous look. The abdomen is somewhat retracted, or at least only slightly distended, and in the right side of the abdomen there is a long, tender, sausage-shaped tumor.

The child has a severe bellyache. Is it due to appendicitis or to tuberculous peritonitis?

It is due to tuberculous peritonitis, because the little boy is distinctly scrofulous in appearance. He has the adenoid face and lower jaw; the chest is covered with enlarged and bluish veins. There are two distinct sulci over the attachment of the diaphragm to the ribs, extending from the sternum outward and downward. The chest is round and infantile in shape. The lymph glands of the neck, the axilla, and the groin are distinctly enlarged. The abdomen is dis-

tended, the child is pot-bellied. The child's appetite has been bad for a long time, and he has not been interested in play. Ausculation over the abdomen shows distinct friction sounds, and palpation and percussion demonstrate the presence of a tumor in the right iliac region. The temperature is low, 99, and rarely 100, and often subnormal, and the pulse is persistently rapid, 100 to 120. The leucocytes are diminished, 4,000 to 5,000 to the cmm. The red corpuscles are 4,000,000 to 4,500,000. The child frequently complains of abdominal pain on urination, and the present attack has been preceded by less severe abdominal pain and by occasional attacks of vomiting. The child has had night sweats since this trouble began, but this is nothing unusual, as he has always snored and sweat at night, especially in the winter and spring.

The child has a severe bellyache. Is it due to appendicitis or to general gastrointestinal infection?

It is due to general gastrointestinal infection, because this is a strong and healthy child; it is the child's second summer; it is the month of June or July, and a warm spell has been followed by a cold, damp night. The disease is epidemic. The child was attacked with a severe abdominal pain, a temperature of 103, a pulse of 110, and a sharp vomiting spell. This was almost immediately followed by a copious watery stool containing undigested food, followed by numerous other stools of a dark green, frothy material, with an offensive sour smell and an acid reaction. The abdomen is not distended, the colic is almost invariably followed by a bowel movement, the ab-

dominal tenderness is not limited to the region of the appendix.

The child has a severe bellyache. Is it due to appendicitis or to pneumonia?

It is due to pneumonia and diaphragmatic pleurisy, because the patient had never suffered of any abdominal disturbance before; she is a girl of 13 or 14, and has been exposed to cold at a picnic. She had a pronounced rigor at the onset, and her temperature is 104, her pulse unusually full, strong, and 110 to the minute; her respirations are 28. She complains of constant, deep, boring pain in the right side of the abdomen, rather higher up than the appendix, which is increased upon taking a full breath. Palpation of the abdomen does not increase the pain, and no area of abdominal tenderness can be discovered. The bowels do not move oftener than usual, and the patient has no tendency to nausea or vomiting. Physical examination of the chest gives no hint of consolidation of the right lung, but there is a hacking cough.

The child has a severe bellyache. Is it due to appendicitis or to calculi in the kidney and ureter?

It is due to urinary calculi, because this 12-year-old boy is otherwise healthy, strong, and vigorous. He has only a trifling rise of temperature, and his pulse is accelerated 20 or 30 beats to the minute only during the agony of the pain. The pain is remittent; it came on suddenly in the night, and several hours after a very hearty meal. The pain is agonizing, and was twice accompanied by profuse vomiting. With each attack the boy grabs the right leg or the right

testicle in his hand, cries with pain, and breaks out into a profuse sweat. After the fourth or fifth paroxysm he urinated, and the urine was slightly bloody. He gets some relief on being placed in a hot, full bath. There is tenderness over the whole right side of the abdomen, but this tenderness is most pronounced when there is a palpating finger below the first rib in the right lumbar region and opposing fingers in the upper part of the abdomen and at the outer border of the right rectus. There is a history of passing gravel by the urethra when the boy was six years old.

The child has a constant epigastric pain. Is it chronic appendicitis or is it tuberculosis of the dorsal vertebræ?

It is tuberculosis of the dorsal vertebræ, because this 8-year-old boy has all the signs of adenoid disease; the retreating lower jaw, the blue veins over the chest, the sulci at the attachment of the diaphragm, the enlarged lymph glands in the groin, the chronic bronchitis. For two or three months he has been losing weight and strength; he has sweat every night; his appetite has been capricious and uncertain. He has shown a tendency to lie down on his back or read with the book on the floor and stretched out over it. When standing or sitting, he has shown a tendency to lop and lean about. He has complained of pain almost entirely in the daytime when he has been moving about and after riding in a buggy or on a bicycle. His temperature is 99, his pulse 100, and his respirations 20. When he is stretched upon a firm, hard table the pain disappears at once. When he is made to sit upon a hard, firm stool he soon leans

forward and places his hands on his knees or lops on an adjoining table. If he is made to sit erect, and the clasped hands are placed over the top of his head, and 20 or 30 pounds pressure is brought suddenly upon his spine, he complains of pain at the pit of the stomach. When the patient hangs from a trapeze or is supported by the head in the palms of the hands of the examiner, he feels a sense of relief and comfort. When he is asked to pick up an object from the floor he squats like a woman in corsets rather than stoops like a supple and untrammeled youth, and if he is stripped and required to lean forward and bend his body to the right or left, a rigidity of two or three of the dorsal vertebræ can be noticed, and even the deviation of a dorsal spine toward the right, toward the left, or dorsalward. The intellect is very clear, the eye bright, and the condition of the nervous system excellent. Urinalysis shows an increase in the phosphates and the solid constituents only. There is no tenderness over the region of the appendix, nor does pressure over any part of the abdomen excite or increase the pain. There is no leucocytosis, and the pain is uninfluenced by the quantity or the time of taking food.

It is impossible to determine the infection of a Meckel's diverticulum, except when it is still attached to the umbilicus and the infection and distention shows itself in the scar of the cord. The same may be said of the infection of the patent urachus. It would naturally be thought of when the infection was pronounced and presented itself at the navel with distinct urinary symptoms.

Tumors of the mesentery and cystic tumors and sarcoma of the kidney occasionally give rise to questions of differential diagnosis of appendicitis when they occur on the right side. Time alone, and the absence of positive symptoms of appendicitis can make the diagnosis.

The question of hernia is not different in children from the same question in adults, and a distended urinary bladder can easily be eliminated by the use of the catheter. Occasionally safety pins, knives, and other small objects have been impacted in the ileocecal valve and given rise to all the symptoms of appendicitis. Fortunately the use of the X-rays discovers most of these objects.

WHEN THE PATIENT IS A YOUNG ADULT 15 TO 45

This young woman has severe abdominal pain, with the symptoms of infection. Is it appendicitis, or is it cholecystitis?

It is cholecystitis, because the patient had a long and severe febrile disease, presumably typhoid, when she was eight years old. Since that time for twenty years she has had sick headaches coming on suddenly in the middle of the day as often as once a week, especially since she was twelve or thirteen years of age. Two or three attacks of sick headache have been accompanied by chills, fever, and severe abdominal pain, with great tenderness and distention of the abdomen, keeping her in bed for two weeks at a time. None of these attacks has been accompanied by any marked jaundice, but even the sick headaches are attended by a slight discoloration of the skin and

conjunctivæ. The present attack began with a chill and a rise of temperature to 104. There was deep paroxysmal pain in the right side of the abdomen and right shoulder, which was partially relieved by vomiting. The bowels have been constipated, but moved with enemas. The urine has been unmodified. On examination the right side of the abdomen is distinctly tender; the right rectus is tense; there is a tumor in the upper right quadrant of the abdomen which extends as low as the umbilicus. On ausculation a friction sound is heard over this tumor on each inspiration and expiration. The region of the appendix is not particularly sensitive; palpation in the lumbar region over the right kidney does not elicit pain. When the colon is distended with air the area of dullness corresponding with the tumor is not modified, and the artificial tympany falls outside of it. Auscultatory percussion indicates a separation between the liver and the tumor.

The gall-bladder and the appendix vermiformis are diverticula of the intestinal tract which are subject to similar and contemporaneous infection, and it is a fact which has often been clinically noticed that they occur together much more frequently than the mathematical curve would predict. It is doubtless due to the fact that such causes as predispose to the infection of the one appendage encourage the infection of the other.

This young woman has severe abdominal pain. Is it due to appendicitis or to mucous colitis?

It is due to mucous colitis, because she is a markedly neurasthenic woman of 35, with a normal pulse,

a normal temperature, and the absence of all symptoms of pus microbe infection. The pain is distinctly paroxysmal, and this is one of a long series of attacks which last a few hours or a day at a time and terminate after the discharge of a considerable quantity of mucus, and even occasionally long shreds somewhat resembling tapeworms. These attacks occur after some unusual mental excitement or disappointment, and are weeks or months apart. They vary greatly in severity, and are accompanied by symptoms which are evidently hysterical. The abdomen is tender everywhere, but especially in the left iliac region, and over the transverse and ascending colon. Charcot's triangle is easily made out. Each attack presents new symptoms of hysteria, some of them difficult to interpret, and some of them grave enough to arouse the most serious alarm.

It must not be forgotten that patients suffering of mucous colitis may suffer at the same time of appendicitis, and the mere fact that a patient is suffering of mucous colitis should not prevent prompt and efficient surgical relief from the coincident disease on account of the inadequacy of the operation to cure the unrelated colitis.

This 150-pound woman of 30 complains of terrible abdominal pain beginning at the pit of the stomach and extending over the whole abdomen. Is it appendicitis, or is it ulcer of the stomach?

It is ulcer of the stomach, because the patient is a hard-working dressmaker, who cooks her own meals in her sewing-room. She is moderately anemic, 4,000,000 red corpuscles, with Fleischel's hemoglobin

index of sixty per cent. She has a moderate leucocytosis varying between 10,000 and 12,000. Her temperature is slightly above normal, 99 to 100. The pain is greatest immediately upon taking food, but sometimes it is relieved when it comes on at three or four o'clock in the afternoon or early in the morning before daylight by taking a large meal. She gets relief in the paroxysm by leaning forward over a hot water bottle firmly applied to her stomach. The pain appears to radiate from the epigastrium and the middle of the back over the whole abdomen and even through the chest. After the attacks the tenderness of the abdomen continues, and the patient has fitted herself with loose clothing, having the waistband well above the hips in the empire style. These attacks have continued over a period of nearly a year, and have varied greatly in intensity and frequency. In two or three of her attacks she has obtained great relief by drinking large quantities of water and vomiting. The vomited matter tasted excessively sour and acrid to her. She never has vomited any blood, and never has noticed that any of her stools were black. The urinary findings are entirely negative, and palpation of the abdomen discovers only a single point of tenderness immediately below the ensiform cartilage and slightly to the left of the median line. This point of tenderness is distinct and invariable. No epigastric pain is produced by pressing over the region of the appendix, and the right rectus is not more tense than the left. Charcot's triangle is absent.

There is another moment in the history of ulcer of the stomach in which it is necessary to differentiate

appendicitis, and that is at the moment of perforation. We are then called upon to decide whether the peritonitis is due to a perforating appendicitis or a perforating ulcer of the stomach. The question must be answered by the previous history of the case, by the result of the examination of stomach contents removed by the stomach tube, and by the apparent localization of the peritonitis. The two most important sources of peritonitis in the upper or cephalic peritoneal cavity are ulcer of the stomach or duodenum and rupture of the biliary tract, and the only source of peritonitis in the lesser omental pouch is ulcer on the dorsal wall of the stomach.

This young man has severe abdominal pain, beginning without a chill, accompanied by headache, vomiting, and a high fever. Is it appendicitis, or is it typhoid fever?

It is typhoid fever, because the patient has been spending two months in a small town where typhoid is endemic. He has been feeling depressed and miserable for two weeks. He has had nosebleed twice during the past week. His pulse is 88, although his temperature is nearly 104. His abdomen is tender everywhere, and especially in the right iliac region, where there is a gurgling sound on pressure. The right rectus, however, is not noticeably more tense than the left, and the tenderness in the right iliac region is not as great as we should expect with an appendicitis and a temperature of 104. The Widal reaction is negative, and there are no rose spots over the abdomen. The patient has a slight hacking cough, but there is no evidence of consolidation or

abnormal sounds in the lungs. The urinalysis shows a small amount of albumin, but no other abnormal constituents. The urine is concentrated and rather scant. The examination of the blood discovers no malarial organisms; there are 5,000,000 red corpuscles, 4,000 white corpuscles to the cmm., and a hemoglobin index of 80.

There is another moment in the history of typhoid in which it may possibly be confounded with appendicitis. When there is evidence of perforation of the bowel and peritonitis, it may be questioned whether it is a case of a perforated appendix or an ambulatory typhoid with perforation. The diagnosis must rest upon the history of the case, and the presence or absence of the enlarged spleen and the Widal reaction. Fortunately the treatment is not modified by the diagnosis except in the hands of such empirics as depend upon the efforts of nature to localize a diffuse peritonitis.

It must be distinctly borne in mind that a patient may have an acute appendicitis at the beginning of a straight typhoid. There seems to be something in the diminished resistance at the end of the so-called prodroma of typhoid which invites appendicitis. In one case at least I removed a highly inflamed and buried appendix on what proved to be the third day of a typical typhoid.

This young woman of thirty has a high fever, distended abdomen, and abdominal colic. Is it appendicitis or acute miliary tuberculosis and tuberculous peritonitis?

It is acute miliary tuberculosis, because the patient

has been indisposed and losing weight and strength for more than six months; she has menstruated irregularly and scantily during all this time, and has failed to menstruate at the last three periods. She has an old cicatricial impairment of the resonance of the apices of both lungs, but otherwise they present no abnormality except a few indistinct, fine bronchial rales. She has had a sharp pleurisy over the right lung several times during the past six months. The heart's apex is normally situated, but there is a small systolic murmur heard over the mitral area. She is bright, quick, intelligent, and active; she has had occasional night sweats during the past three or four months. Two months ago she had a febrile attack which was pronounced la grippe. It kept her in bed for three or four days, and was accompanied by severe pain in her right chest. Since that time she has had occasional attacks of sharp, quick abdominal pain, especially after meals. The abdomen has been gradually increasing in size, and had felt noticeably tender to the pressure of her clothing. Four days ago she became sick again; her fever increased, her pulse became rapid, and her respirations considerably faster. Her temperature now is 104, her respirations 24, and her pulse 130. She has been suffering most agonizing pain in the lower right hand quadrant of the abdomen during the past eight hours; the abdomen has considerably increased in size, and she has vomited three or four times. The bowels have been moved with an enema. Several times she has appeared considerably cyanotic. Palpation of the abdomen discovers a general tenderness, most intense over the right iliac

region. The right rectus is not noticeably more tense than the left. The palpating hand occasionally feels the violent peristaltic movement of the underlying intestine. The liver dullness is considerably raised and verges off above into the subnormal resonance of the lung. The excursions of the liver seem to be diminished, and full inspiration produces an increase in the abdominal pain. By vaginal and rectal examination the uterus is found to be small, hard, and almost immovably fixed in the pelvis. The pelvic floor seems to be thick, hard, and slightly irregular. Two or three pea-sized nodules, apparently lymph glands, can be felt on each side of the uterus in the retropelvic peritoneum. The spleen is not palpable. The examination of the cornea and retina is negative. The urine contains a small amount of albumin, an increased amount of chlorides, and phosphates; it is scanty, high colored, and gives the Diazo reaction. The blood contains 4,500,000 red corpuscles, 5,500 white corpuscles to the cmm., and a hemoglobin index of 75. The Widal reaction is absent; there are no malarial organisms in the blood.

The threatened obstruction of the bowels is probably a terminal symptom in this case, and is due to the products of an old tuberculous peritonitis rather than to the adhesions of the peritonitis produced by the present explosion. The enlarged lymph glands in the retropelvic peritoneum are quite significant of tuberculous peritonitis, and they may be recognized in both men and women.

This middle-aged man, weighing 220 pounds, has a sudden severe abdominal colic, with distention of the

abdomen and fever. Is it appendicitis, or is it acute pancreatitis?

It is acute pancreatitis, because he has suffered of indigestion for years. He has had eight or more attacks of mild biliary colic, the last of which was six years ago. In each of these attacks he had some fever, and during the last he had considerable fever and very noticeable jaundice. This attack terminated suddenly with diarrhea. The present colic came on several hours after taking an unusually hearty luncheon. It was so sudden and agonizing that the patient was nauseated and vomited freely. He was taken to his home, his nausea continued, and the abdomen has gradually increased in size. Every effort at giving him stimulants has been followed by vomiting. He has received two hypodermics of a quarter of a grain of morphine each, but has had no relief from pain. The pain is at the pit of the stomach. His temperature is 100 four hours after the beginning of the pain, his pulse 96. An examination of his blood gives 5,500,000 red corpuscles and 15,000 white corpuscles to the cmm. He has a hemoglobin index of 80. His urine contains a small amount of albumin and gives a pronounced reaction to the Fehling solution. It is concentrated, high colored, but contains no other abnormal constituents. Palpation of the abdomen is unsatisfactory, yet there is a very distinct area of tenderness immediately under the end of the sternum. It is impossible to palpate any tumor there. The whole abdomen is slightly tender on palpation, but the pain all radiates to or from the pit of the stomach.

Twelve hours later his temperature has risen to

102, his pulse to 100, and his respirations remain unmodified. He has been during the whole time in a most agonizing distress, though the sharp, colicky pain has somewhat subsided. The abdomen is still more distended and tympanitic, although several large enemas have been given and one or two large fecal discharges secured. Little or no gas has passed the bowel, and the efforts at stool have been accompanied by terrible pain at the pit of the stomach. There is a leucocytosis of 25,000; the urine is scant, and contains more albumin and less sugar than at the preceding examination. There appears to be a tumor at the pit of the stomach, which is excessively tender on palpation. It moves slightly downward, caudalward, with each full inspiration. This manœuver is attended by great pain.

Acute pancreatitis is a disease of greater frequency and of less mortality than we are prepared at the present time to admit. It usually occurs when the patient gives a history of long-continued biliary disease, but it sometimes follows traumatism in people without this history. While it is generally a disease of mature adults or even the aged, it does occur in young, vigorous subjects. It seems to be instituted by the sudden obliteration and infection of the last outlet to the pancreas.

This rather spare man of 40 is suffering the most agonizing pain in the right side of his abdomen. Is it appendicitis, or is it the passage of a calculus in the ureter?

It is the passage of a calculus in the ureter, because this pain came on instantaneously at its greatest

severity, and has been constantly referred to the right iliac region, and has been reflected gradually into the right side, skin of the thigh and the right testicle. The pain has been remittent, and has occurred at very short intervals. Large doses of morphine hypodermically, three-quarters of a grain in two hours, have failed to relieve the pain. The greatest relief which has been obtained was secured by a very hot, full bath. Urine has been repeatedly passed with strangury and vesicle tenesmus. The temperature twelve hours after the beginning of the attack is 100, the pulse 100, but it is increased 20 and even 30 beats with each exacerbation of the pain. These exacerbations occur now at about half-hour intervals. They are not quite so severe, and they are less remittent than during the first two or three hours of the distress. During the first two or three attacks of pain there was nausea and vomiting. Nausea has appeared occasionally even during the past three hours, but the patient has not vomited. He has taken an abundance of hot drinks, has had two or three enemas of large quantities of hot water. These enemas gave some relief from the pain, and they were followed by moderate fecal discharges. The abdomen is not distended; it is rather contracted. This is more noticeable during the paroxysms of pain. The testicles are very much retracted, and during the paroxysm the right testicle has been actually forced into the inguinal ring by the violent cremaster contraction. Palpation of the abdomen reveals an exquisite area of tenderness in the region of the appendix. The right kidney is easily palpable. It is somewhat tender on pressure at full inspiration. There has been

no pain at the pit of the stomach, even after vomiting, and there is no tenderness elsewhere in the abdomen. The urine is abundant; it has a low specific gravity; it contains the faintest trace of albumin, a few red and white corpuscles, and a considerable quantity of mucus. It is rather high colored, and the percentage of phosphates and chlorides is high. His blood contains 5,000,000 red corpuscles and 7,000 white corpuscles to the cmm., and a hemoglobin index of 75. On cocainizing the urethra and urinary bladder and passing the electric cystoscope, rendering the bladder dry and filling it with air, a distinct stream of urine is seen to squirt out of the left ureter at 20-second intervals, while from the right ureter, although it is very patulous and apparently swollen and easily visible, only a small drop of fluid is discharged after several seconds of waiting. Ureteral catheters are passed into each ureter; the bladder is filled with a mythylene blue solution, the cystoscope withdrawn, and at the end of an hour no urine is collected from the right ureter, while such a quantity of urine is collected from the left ureter as would account for the total 24-hour specimen.

This 40-year-old man has a sudden, severe, agonizing pain at the pit of the stomach. Is it appendicitis, or is it a crisis of locomotor ataxia?

It is a crisis of locomotor ataxia, because the patient is an anemic man, who has noticed a peculiar sensation in his legs for the last half year. He has been otherwise healthy, and has complained of nothing except the loss of sexual power, which has been gradually progressing since he was 35. During the

past six months he has occasionally tripped and fallen forward; he has a peculiar uncertainty and hesitancy in articulation, and is unable to write or do any other simple mechanical act, and at the same time complete a sentence. On examination the knee-reflex is absent, and the eyes fail to react to light. The examination of the stomach contents discloses no abnormality, and the examination of the blood and urine yields no evidence of infection. The pain is not increased on palpation of the abdomen, and rigidity of the right rectus is absent.

Incarcerated hernia reduced from the inguinal ring, hernia in the obturator foramen, the linea alba, or one of the intraabdominal foramina, can be diagnosed only after the abdomen is opened, unless there is something in the history which will suggest very strongly one of these conditions. If there was an evident hernia in the inguinal ring which was reduced with or without an anesthetic, and symptoms of obstruction of the bowel followed, it is reasonable to suppose the hernia was reduced en masse. If a patient suffered a severe compression or strain, and the pain and other symptoms appeared at once, retroperitoneal hernias may be thought of. If the tender spot is in the linea alba, and there is any evidence of tumor, a hernia in this region might be considered. Hematomas and the abscesses which follow hematomas in the abdominal wall in the region of the appendix are excessively rare conditions. They are the result of unusual muscular efforts, or of blows or compressions, and the history is easily at hand. The symptoms of tuberculous peritonitis and those of

tuberculosis of the kidney are sufficiently brought forward in the paragraph on acute miliary tuberculosis and calculus of the kidney.

Many cases of appendicitis are referred to as gastritis, gastralgia, or gastrodynia, but there is generally no reason to make such a diagnosis. An appendicitis may occur in a patient suffering of acute gastritis, and gastrointestinal catarrh. The acute gastritis then seems to be an exciting cause. It is the result of alcoholism or unusual irritating food. The gastritis, however, without appendicitis, is unattended by a tumor, a tenderness which produces pain reflected to the pit of the stomach, and it is rarely accompanied by as much fever and as high a grade of leucocytosis in adults as is appendicitis.

Hysteria may simulate anything, and why not appendicitis? In my own experience, however, this has never occurred. I have seen a case of a young German of erudition and high social connection who spent his time for years in going from one hospital to another to be operated upon for appendicitis. He was operated on three or four times before he came into my hands, and I, discovering his habit, sent him away. He was afterwards operated upon in Chicago and adjoining cities at least three times, and at the last operation, in Indianapolis, he lost his life.

In one case the presence of an undescended right testicle, with symptoms of appendicitis, raised the question of an orchitis in this testicle which was afterwards cleared up by finding and removing an excessively large and highly inflamed testicle and epididymis. This tumor was so large that it nearly filled the lower

right side of the pelvis, and the tenderness was so great and the temperature so high that I thought of a periappendicular abscess.

Gangrene of the intestine from obliteration of the mesenteric artery or obstruction of the portal circulation occasionally simulates appendicitis. The condition is relatively rare, the differential diagnosis difficult, if not impossible, without marked symptoms of endocarditis until the abdomen is opened; the indications are imperative for an immediate laparotomy. I have myself met with two cases, in one of which the diagnosis was appendicitis.

The onset of uremia with severe epigastric pain might simulate the beginning of an attack of appendicitis, and the general appearance of the patient might suggest the intoxication of infection. Occasionally the temperature is high, and thus a number of symptoms would point to this disease; but the examination of the urine, and the absence of tenderness over the appendix, and a careful study of the condition of the arteries and the heart would rectify the error.

WHEN THE PATIENT IS A FEMALE 15 TO 45.

This middle-aged woman had a sudden, terrible abdominal pain and went into collapse. Is it a ruptured appendix or periappendicular abscess, or is it a ruptured extrauterine pregnancy?

It is a ruptured extrauterine pregnancy, because this previously healthy woman is apparently pregnant; her nipples are pigmented, the cervix is soft, she has skipped three menstrual periods, and has believed during the past two months that she was pregnant.

Her pulse is 160; her temperature 98 in the rectum; she is pale and almost pulseless at the wrist; a half hour after the severe abdominal pain she fell into a profuse sweat; her voice is weak; she has heard peculiar ringing sounds in her ears, and has apparently been unconscious several minutes at a time during the past three hours. Palpation of the abdomen shows an indistinct semi-fluctuating and resisting mass in the right pelvis. The urinary bladder contains only four ounces of perfectly clear and normal urine as shown by the catheter.

This young woman is found suffering of most intense abdominal pain. Is it appendicitis, or is it abortion?

It is abortion, because she has been previously healthy, and during the past two months has shown an unusual bloom of health. She has given no history of the absence of menstruation, but the nipples are distinctly pigmented, and the breasts are unusually firm and erectile; the vagina contains a little blood, and the cervix appears somewhat ecchymotic, and a bloody discharge exudes from it. The cervix is noticeably larger and softer than normal. The uterus itself is three or three and a half inches long as measured by bimanual palpation, and distinctly tender on pressure and movement. The temperature is 103, and the pulse 110. There is a moderate leucocytosis, 12,000 to the cmm. The general abdominal tenderness is not increased in the region of the appendix, and the right rectus is not noticeably tense. The lungs and heart present no evidence of disease.

This young woman has fever, chills, rapid pulse,

great pain in the right side of the abdomen and pelvis, and abdominal tenderness and distention. Is she suffering of appendicitis or pyosalpinx of the right tube?

She is suffering of pyosalpinx, because she has all the symptoms and signs of suppurative disease; moreover, abdominal palpation is painful to the patient, and there is a special tenderness on vaginal examination when the finger is brought up into the right fornix, which is thick, hard, and resisting. The cervix is in the left side of the vagina and points toward the right; the fundus is in the left iliac region. The uterus is immovable, and attempts at pressing it forward or lateralward produce pain. The history of the case and the condition of the Bartholinian glands and the urinary meatus is suggestive of gonorrheal disease. The right rectus is not noticeably more tense than the left; McBurney's point is not noticeably tender.

This young woman is suffering of severe abdominal pain confined to the lower right side of the abdomen. Is it appendicitis, or is it prolapse of the ovary?

It is prolapse of the ovary, because she has all the appearances of a virgin; she was attacked with this pain during a tennis game on an unusual motion and exertion. It produced faintness, nausea, and almost collapse, and was followed by a severe protracted pain and abdominal tenderness. Her temperature is normal, and her pulse 88. She has urinated, and the urine is perfectly normal.

This middle-aged woman, who has considered herself pregnant for four months, in spite of regular menstruation, suffered of an excruciating abdominal

pain, with rapid distention of the abdomen. Is it appendicitis, or is it ovarian tumor with a twisted pedicle?

It is a tumor of the right ovary with twisted pedicle, because the uterus itself is not enlarged; it lies on the left side of the pelvis, and the cervix is pointed to the right. The right fornix is not tender; it is soft and so high up as to be almost inaccessible. There is a large tumor suggesting a uterus at seven months in size filling the lower abdominal space. The bladder is empty after the removal of three ounces of normal urine. About this tumor the abdomen is excessively tender and tympanitic, but both flanks are dull and pseudo-fluctuating when the patient is on her back. There is no tenderness over the region of the appendix more than over any other part of the abdomen. She complains that since the onset of the pain, six hours ago, the abdomen has increased greatly in size in spite of a very liberal movement of the bowels, which was secured by an enema. Her temperature is 100, and her pulse 120. She is excessively anxious, and complains of pain, nausea, faintness, and dizziness. Her leucocyte count is 30,000 to the cmm.

This young woman was attacked with excruciating pain in the right side of the abdomen. Is it appendicitis, or is it tort of the ureter of a floating right kidney?

It is tort of the ureter of a floating right kidney, because this patient has been known to have a floating right kidney since the birth of her child, four years ago. Dressed in extremely tight corsets, she was taking care of this child when the pain came on.

Although the pain has continued for eighteen hours, the temperature is only 100, and the pulse 88, and there is no abdominal distention. In the right side of the abdomen, and in the region of the appendix, there is a large, apparently spherical, tumor, not less than four inches in diameter, excessively tender on pressure, and absolutely immovable by external palpation. The normal area of dullness for the right kidney is tympanitic, and there is a distinct depression under the right twelfth rib. The pain which the patient suffers was attended during the first few hours with urinary tenesmus.

WHEN THE PATIENT IS AN ADULT OVER 45.

This 60-year-old man has distention of the abdomen, fecal vomiting, and collapse. Does he suffer of periappendicular peritonitis and obstruction of the bowel or carcinoma of the cecum?

He is suffering of carcinoma of the cecum, because this acute attack was preceded by several months of loss of weight, of abdominal torment, and difficulty of moving his bowels. Large enemas would bring away only small discharges; laxatives were constantly necessary. He complained during the last month or two of a fecal taste in the mouth. His abdomen swelled up on several occasions, but he had no pain in the intervals between the laxative. Four days ago the last trace of fecal matter passed the bowels. Since that time he has passed nothing but a few shreds of mucus with the enemas which have been given him. The abdomen is enormously distended, and the abdominal walls are stretched to the utmost. The respi-

rations are shallow, and there is some embarrassment of the heart. He lies with the knees up and the head forward, and appears considerably cyanotic. He is not cachectic. His temperature is 100, and his pulse 96, his respirations 20. Just after vomiting he is covered with a cold sweat. Palpation of the abdomen is unsatisfactory, and percussion discovers no tumor. There appears to be no dullness in either flank, and rectal examination discloses no evidence of a tumor in the pelvis; the prostate is moderately hypertrophied and perfectly smooth. The lymph glands around the navel are not enlarged, but the navel protrudes with the general tympanites. The lymph glands in the groin are not enlarged. There are no abnormal constituents in the urine, which is concentrated and heavy and rather high colored. The indican reaction is unusually pronounced. There are 3,200,000 red corpuscles, 8,000 white corpuscles, and a homoglobin index of 35.

Carcinoma of the colon sometimes appears without pain and becomes a tumor the size of the fist and easily palpable without giving rise to any disturbance until symptoms of obstruction appear.

Sometimes carcinoma elsewhere in the abdomen gives rise to abdominal colic and such symptoms as might lead to a suspicion of appendicitis. Carcinoma of the pylorus suggests by its deep-seated pain the pain of early appendicitis, but the distention of the stomach and the diminished hydrochloric acid in the stomach contents is suggestive if not exclusively diagnostic.

In old men with prostatic abscesses a perivesicle

abscess may appear which might resemble appendicitis in its symptoms and course. It would naturally demand entirely different treatment, and would hardly be mistaken for a periappendicular abscess except in very atypical manifestations.

Impaction of feces is a very common occurrence in the aged, and especially in aged women. It gives rise to the fever, the tumor, and the pain which might be mistaken for appendicitis. It is sometimes very difficult to diagnose, and impaction has been cut down upon with almost every conceivable diagnosis. When the impaction occurs in a dilated haustra of the cecum or colon, it is impossible to effect dislodgment, and it gives rise to symptoms of sepsis through necrosis of the mucosa and ulceration.

CHAPTER VII

THE TREATMENT OF APPENDICITIS

Appendicitis calls for appendicectomy; performed under four conditions. Appendicectomy of the free appendix; the six stages of the operation; the preparation of the patient and instruments; the laparotomy; the discovery of the appendix; the ligation of the mesentery and the removal of the appendix; the closure of the laparotomy wound; the protection of the wound after treatment; illustrative cases. Appendicectomy of the adherent appendix without abscess; the dangers of enucleation; the application of the tampon; the removal of the tampon; illustrative cases. Appendicectomy of the free or adherent appendix with abscess; the difficulties and dangers of this procedure; the secondary operation; the remote consequences of perityphlitic abscess. The anesthesia for appendicectomy and dangers of anesthesia; contra-indications to general anesthesia. The early and late operation.

The treatment of appendicitis is appendicectomy. When the disease has gone beyond the possibility of this procedure, it consists in such preliminary operation as will eventually lead to appendicectomy. There is no medical treatment, there is no dietetic treatment, there is no electrical treatment, there is no hydriotic treatment, which is effective in removing, staying, or preventing this disease. Every therapeutic measure

other than appendicectomy which has been proposed or practiced has added to the confusion of the literature and the disaster of the patient.

The treatment of appendicitis must be considered separately for groups of cases in the various stages of the progress of the disease. The ideal time for the removal of the appendix is in the first stage while the appendix is free in the general peritoneal cavity. The operation is then the simplest, the safest, and the most effective. It is wholly devoid of dangerous complications. When the appendix has become attached to adjoining organs or buried in peritoneal adhesions, but is unaccompanied by extra-appendicular abscesses, it may still be removed with relative ease and safety. When, however, the appendix is surrounded by or connected with abscesses which have gone out from the appendix, the operation is accompanied by all of the dangers of the secondary peritonitis.

APPENDICECTOMY OF THE FREE APPENDIX

When the appendix is free in the general peritoneal cavity, or only attached to surrounding viscera by old and attenuated adhesions, appendicectomy is at once the easiest, the most highly specialized, and the most simplified of all forms of laparotomy. It consists essentially of six steps (1) the preparation of the patient, the abdominal wall, the instruments, and dressings; (2) the laparotomy, with intermuscular separation of the abdominal wall; (3) the discovery and removal of the appendix through the abdominal opening; (4) the ligation of the mesentery and ampu-

tation of the appendix through the valve of Gerlach, with complete covering of all raw peritoneal surfaces; (5) the closure of the several layers of the abdominal wall; and (6) the protection of the wound with an antiseptic dressing.

1. Appendicectomy for the free appendix is performed under two entirely distinct conditions: In the first instance when the patient is in the midst of an attack, suffering intense pain, with exquisite tenderness of the abdomen, and either vomiting or at least greatly distressed. In the second instance it is performed for the removal of an appendix which is chronically inflamed, but for the time quiescent. In the former instance the preparation of the patient is very much limited by the necessity of an immediate operation. In the latter instance there is an abundance of time to put the patient's urinary and intestinal tracts in the best possible condition.

The examination of the urine, the blood, and the respiratory apparatus has been conducted for diagnostic purposes. It is desirable to empty the colon with an enema in order to relieve the patient of the distress which accompanies this procedure immediately after the operation. In the most acute cases it is necessary to give the patient a thorough bath and to shave the abdomen and pubes and render the skin at the site of operation as clean as possible by the application of a compress saturated with a solution of green soap in ether and alcohol. This is all that can be done in the acute cases. In the chronic cases the patient can be kept in bed for twenty-four hours and the diet limited to liquids and the most digestible solids. A vigorous

cathartic can be given, and if a general anesthetic is to be used the tissues may be filled with liquids by giving the patient large quantities of water or other fluids until the hour before the anesthetic. The treatment of the intestinal tract can be finished by washing out the colon with a high enema six hours before the operation and a low enema three hours later. The patient can empty the colon more perfectly if he is allowed to go to the closet for this purpose.

It would be wholly redundant to attempt to describe the necessary preparations of the dressings, the operating-room, and the instruments in this place. The technique of the antiseptic operation is a chapter so long, so full of detail, that it must be studied in the principles of bacteriology and in the practice of the best operating-room. No operator is fit to undertake an appendicectomy except in the most threatening case without a thorough preparation in antiseptic technique and a permanent and well-trained corps of assistants and nurses.

2. The appendix is approached by the smallest incision which the operator is able to work through. There are several directions in which the incision may be made, but in every instance it passes through the skin directly over the so-called McBurney's point. I am accustomed to use the incision which is made parallel with the outer border of the right rectus muscle. In the adult of an average weight of 160 pounds the incision is not more than an inch and a quarter long. It is made with a single cut of the knife through the skin and down to the fascia of the rectus. It meets with no blood-vessel which requires ligation. The

conjoined sheaths of the rectus and the oblique muscles is then divided for a distance of an inch so as to expose the rectus. The bundles of muscle fibers are then drawn with a smooth retractor toward the linea alba, and the remainder of the conjoined fascia under the outer edge of the rectus is opened with the scissors. The deep epigastric artery lies medial to this incision, and is in no danger of being injured. The peritoneum is then picked up and divided with the scissors. As each layer of the fascia is divided it is grasped with an artery forceps by the operator and his assistant, the one on one side and the other on the other side, and held upward over the edge of the wound. The peritoneum is treated in the same manner. It is rarely necessary to pinch any bleeding point in the fat or extraperitoneal tissue. The beginner will usually make a longer incision; he will therefore cut more blood-vessels and have more difficulty in closing his wound. The patient will have more pain; he will be obliged to stay in bed longer; there will be more risk of infection and more danger of hernia.

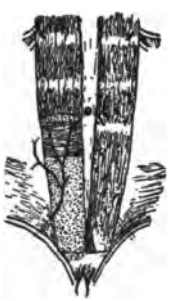

Fig. 28. Relation of deep epigastric artery to rectus muscle.

A diagrammatic transvere section of the anterior abdominal wall at the site of operation is shown in Figs. 29 and 30, and the course of the epigastric artery under the rectus muscle is shown in diagram Fig. 28.

3. The appendix is sought for with the right index finger. It is inserted through the incision after all bleeding has been stopped, and its tip follows the

ventral wall caudad to the crest of the ilium, and by a sweep the iliac vessels are brought against its tip. The finger is then brought cephalad until it feels the head of the cecum and the ileocecal mesentery and valve. By this manœuver the firm, distended, and erectile appendix is usually recognized. If it has not been found, the finger is carried cephalad and lateralward in the arc of a circle through the ileocolic fossa, and then if the appendix is not found, the finger is thrown over the retrocecal fold into the retrocecal

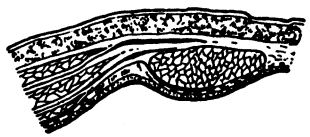

Fig. 29. Section of rectus and abdominal wall below umbilicus.

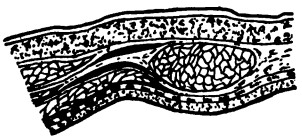

Fig. 30. Section of rectus and abdominal wall above the umbilicus.

fossa; and if the appendix is not yet found, the finger is carried cephalad over the colon into the ileocolic fossa, and last of all into the ileocecal fossa, where the search began. This manœuver rarely fails to discover the appendix, and when once discovered it is easily brought into the little opening on the hooked finger. Occasionally it is necessary to bring the head of the cecum into view in the wound, and inspect it carefully to find the attachment of the appendix and its mesentery.

The appendix is grasped with an artery forceps and the finger withdrawn. With a second artery forceps the attachment of the appendix to the colon is grasped and brought into the wound so that the mesentery of

the appendix is plainly exposed. During this manœuver the abdominal wound is drawn apart by means of two smooth retractors (not shown in the drawing), held by the assistants from opposite sides in such a manner as to depress the ventral abdominal wall and bring it as near as possible to the dorsal, thus making the strain upon the appendix and its attachment as light as possible. No sponges are inserted into the abdomen, and none of the viscera except the head of the cecum is brought into view. The minimum amount of traumatism and manipulation is practiced. The mesentery is compressed with another artery forceps. Fig. 31.

4. The mesentery is ligated and the appendix amputated with these viscera alone in full view. The drawing, Fig. 31, shows a loop of the colon in the wound with the two artery forceps attached. This makes the understanding of the anatomic relations easier, but the colon should never be brought into view. A smooth needle or a sharp artery forceps, armed with intermediate catgut, is passed as close as possible to the base of the appendix through the mesentery, and the mesentery is ligated as far as possible from the appendix. During the ligation the appendix should be allowed to fall forward so that the mesentery is loose and flaccid. The artery forceps upon the mesentery should be removed as the ligature is tied. Two or three knots should be slowly and firmly applied over the first knot. The mesentery is separated from the appendix as near the appendix as possible, and the ends of the catgut cut away. The base of the appendix is now surrounded

with a purse-string suture of fine twisted silk, threaded in a small, straight cambric needle. The artery for-

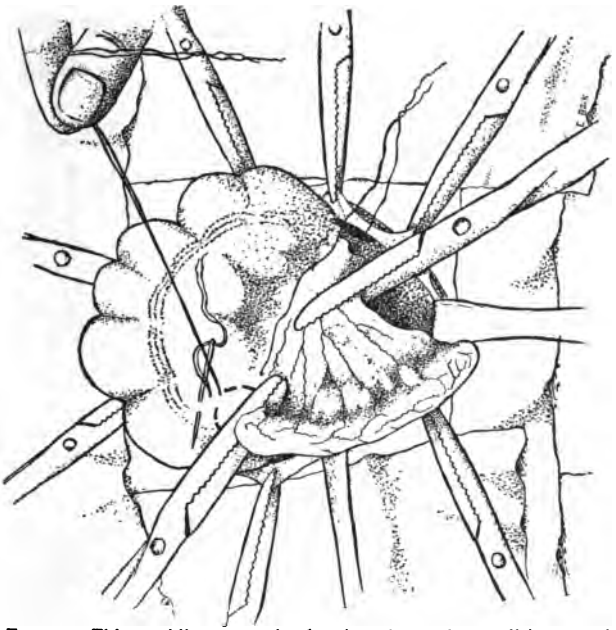

FIG. 31. This semidiagrammatic drawing shows the conditions at the end of the third stage of the procedure when the appendix has been discovered and brought into the wound. In order to show the anatomic relations a loop of colon has been thrown into view. This should, however, be avoided during the operation. The valve of Gerlach is grasped with one artery forceps, the mesentery is compressed with another. The base of the appendix is already surrounded with a purse-string suture.

ceps upon the valve of Gerlach is removed, and the appendix cut away through the compressed tissue. The mucous membrane of the stump is cauterized with a drop of strong carbolic acid on the end of a tooth-pick. The cauterized stump is grasped with a pair of fine dissecting forceps, Fig. 32 and Fig. 33, in the hands

of an assistant, and inverted while the operator ties the purse-string suture. With the same needle and thread

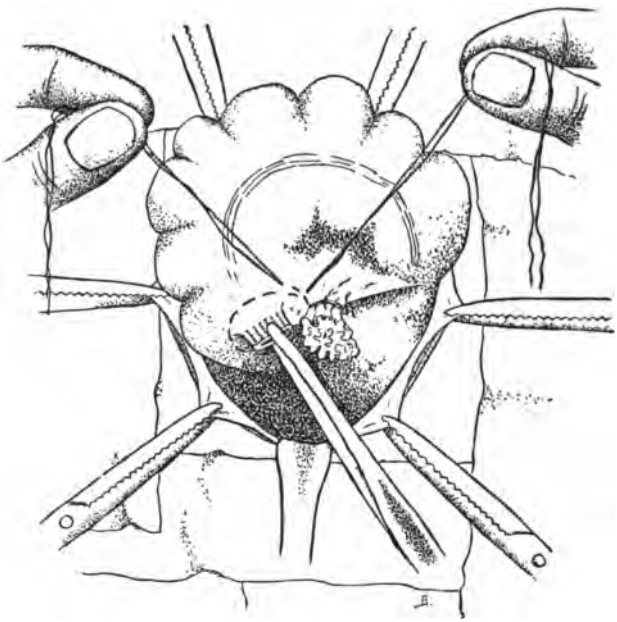

FIG. 32. This semidiagrammatic drawing shows the conditions in the midst of the fourth stage of the operation. The mesentery has been ligated and cut away from the appendix; the base of the appendix has been surrounded with a purse-string suture, penetrating only the peritoneal and muscular coats of the cecum. The base of the appendix has been divided through the compressed valve of Gerlach. The mucous membrane exposed by this incision has been sterilized and destroyed with strong carbolic acid. The stump of the appendix is already grasped in the delicate smooth dissecting forceps ready to be inverted when the purse-string suture is tied. The artist has erroneously shown this suture as a double thread.

the field of operation is still further inverted by a row of stitches covering in the purse-string suture and also the denuded stump of the mesentery. When there is any bleeding from the denuded portion of the cecum,

this is first stopped and the denudation covered, and last of all, the stump of the mesentery turned in. Absolutely no denuded intestine is left to encourage adhesions or produce pain.

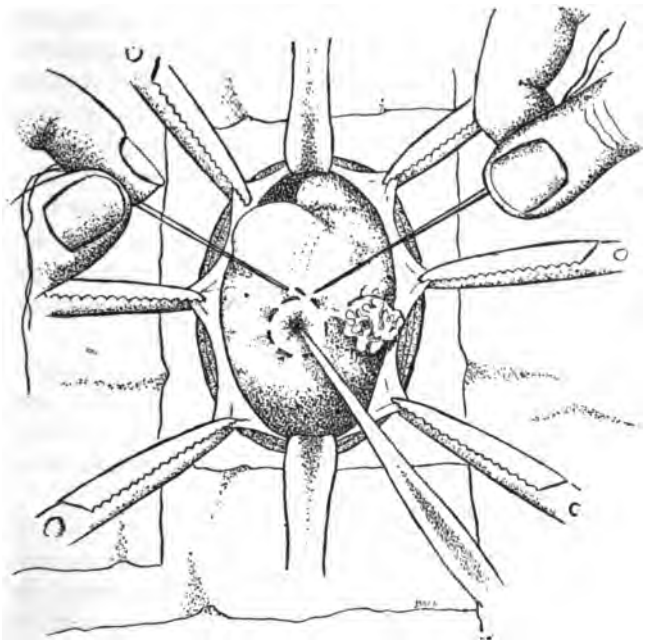

FIG. 33. Diagrammatic drawing showing the inversion of the stump of the appendix immediately before the knot is made in the purse-string suture. This drawing shows the appearance of the field of operation from the beginning to the end.

5. After the wound is carefully sponged out the artery forceps which are attached to the peritoneum are brought together while the artery forceps upon the fascia are still held apart. With a small catgut continuous suture the peritoneum is brought together, the

peritoneal cavity closed, and the forceps removed. For this purpose a smooth, full curved, short needle and No. 1 or 0 catgut are used. Another short, smooth needle, threaded with strong, intermediate catgut, is used to put two or three interrupted stitches through all the fascias; the artery forceps are removed, and these two or three stitches are tied firmly, but not too tightly. Three knots are used to prevent slipping which sometimes occurs in poorly prepared catgut. The wound is again sponged out and all bleeding stopped. Two fine catgut stitches are placed so as to bring the fat together, and the skin is brought in close apposition with two or three interrupted silkworm gut stitches, inserted with very sharp and rather small, straight needles.

6. The field of operation and six inches about it are covered with sterilized, absorbent gauze, and covered again with a compress of sterilized gauze and cotton. This is held on with a broad abdominal band and a perineal strap.

If the patient has been operated upon with a local anesthetic, or with a local anesthetic and nitrous oxide gas for the latter half of the operation, he will be awake by the time the dressings are applied, and can assist himself onto the cart, or even walk to his own room. Under these circumstances there is likely to be no vomiting. If chloroform or ether has been administered, the patient is apt to vomit soon after being lifted onto the cart or put to bed. Little has been accomplished by remedies or inhalations to stop or prevent the vomiting. Some patients get great relief from inhalations of vinegar, and others by inhalations

of the essential oils. I have relied entirely upon making the anesthetic as short as possible and keeping the stomach empty. It has always appeared to me that the erect position prevented vomiting, and therefore I have encouraged patients to sit up as soon as the anesthesia had passed away. When the bowels move, or when the patient urinates, he can be allowed to sit up on the commode or slop-jar. If the small incision was made and no drainage was necessary, the patient ought to sit up in his chair and eat his meals on the day following the operation, and after that time walk about, have the stitches removed, and leave the hospital by the end of a week. The following brief histories are given to illustrate the course of a few of my patients:

Mr. C. W., 26 years of age, had suffered for several years of severe abdominal pain, which was referred to the small of the back and pelvis, and was aggravated by standing, walking, and lifting. He attributed this pain to gonorrheal prostatitis, of which he had a severe attack, with abscess formation, when he was 19 years of age. The tenderness and pain were more pronounced upon the right side, and although there was never any attack in which he was confined to bed, he had a number of attacks in which there was a continued fever of 100 or 101, with localized peritonitis and some distention. The bowels were uniformly constipated, and he frequently had attacks of mild jaundice, which was observable only in the conjunctivæ on account of his swarthy skin. In December, 1903, I examined him and found a distinct rigidity of the right rectus, a tumor and area of tenderness in the region of the appendix, a slight jaundice, a pronounced indicanuria, and a moderate leucocytosis. The temperature at the time was a degree above normal, and the digestion had been disturbed by a long journey on the train. Two months later he came to the hospital, and was under observation for a week. During all this time he was about the hospital, and his temperature remained

low, his urine free from albumin and casts, except for a small show of albumin due to the gonorrheal discharge. The pain and tenderness, the tumor and rigidity of the right rectus, remained, and the leucocytes kept persistently above 10,000. On the 26th of February he was prepared for appendicectomy. The skin was shaved and covered with a dressing, and on the morning of the 27th, after the usual care for the intestinal tract, the skin was infiltrated with a Schleich's solution and the abdomen opened. The patient took several drinks of whiskey during the procedure, and suffered very little pain until the finger was passed into the peritoneal cavity. Although the appendix could be distinctly felt it was so concealed that it could not be grasped with the finger and brought into the wound. The pain of repeated attempts to secure the appendix required the administration of a few whiffs of chloroform. When the cecum was brought into the wound, a slit was made in the retrocecal peritoneal fold over the stump of the appendix which could be easily grasped with the index finger, and the appendix at once jumped through the opening into view. It was removed, the wound closed, the patient sat up the next day, and left the hospital at the end of the fourth day.

Mr. B. R., 27 years old, consulted me in January, 1904, for appendicitis, which had been diagnosed in repeated attacks by his local physician. As a young man he had suffered of a palmar abscess and very extensive suppuration in the arm, with pyemic abscesses in several other parts of the body. During the past six years he had worked very hard at scientific and literary investigations. He was suffering of a mild neurasthenia. His work was continually interrupted by attacks of abdominal pain, which came on soon after eating and were unattended by hyperchlorhydria. In the right iliac region was a very palpable and tender tumor which was protected by a firm right rectus muscle. Repeated examinations under the most favorable circumstances established this finding. There was a moderate leucocytosis, no temperature above normal, and no evidence of disease of the kidneys. He was operated upon January 28th at the Wesley Hospital. An incision an inch long on the outer border of the right rectus was made, the appendix recognized and brought into the wound at once and removed in the usual manner. The peritoneum and

fascia were closed with two rows of catgut stitches, and the skin held together with silkworm gut. The appendix had a constriction about half an inch from its distal end, and the mesentery was full of enlarged lymph glands. The patient sat up and shaved himself on the morning after the operation, attended a clinic on the second day, was about the hospital the rest of the time, and left the hospital one week after his operation. He had liquid diet during the first twenty-four hours, a light diet on the two following days, and a full diet afterwards.

The following table gives the principal details of all my cases operated upon during the past year of which I have authentic records:

Initials.	Form of Disease.	Stay in Bed.	Stay in Hospital.
W. M.	Chronic recurring.	4 days.	6 days.
P. B.	Acute cystic.	3 days.	8 days.
E. G.	Chronic recurring.	12 days.	21 days; suppurating skin.
F. F.	Perityphlitic abscess.	11 days.	21 days, with nurse.
W. H.	Chronic recurring.	10 days.	15 days; local anesthesia.
P. Be.	Acute exacerbation.	7 days.	7 days; suppurating skin.
W. K.	After exacerbation.	14 days.	17 days; drainage.
M. S.	Chronic recurring.	21 days.	25 days; fascia suppuration.
G. G. S.	Chronic recurring.	7 days.	8 days.
M. P.	Acute exacerbation.	4 days.	7 days.
M. C.	Acute exacerbation.	2 days.	4 days.
K. B.	Chronic recurring.	3 days.	6 days; drainage.
B. P.	Diffuse peritonitis.	14 days.	21 days; drainage.
K. J.	Chronic recurring.	3 days.	5 days.
P. S.	Chronic recurring.	1 day.	6 days.
H. R.	Chronic recurring.	1 day.	7 days.
E. J.	Acute exacerbation.	6 hours.	5 days.
B. R.	Chronic recurring.	1 day.	7 days; walked around all week.
H. R.	Chronic recurring.	5 hours.	10 days; out doors after 7th day.

Initials.	Form of Disease.	Stay in Bed.	Stay in Hospital.
J. W.	Chronic recurring.	3 days.	7 days.
Mrs. M.	Chronic recurring.	10 days.	37 days; hysteria.
G. W.	Chronic recurring.	1 day.	5 days.
L. C.	Chronic recurring.	1 day.	6 days.
W. S.	Chronic recurring.	36 hours.	6 days.
J. Y.	Chronic recurring.	22 hours.	6 days.
J. M.	Chronic recurring.	46 hours.	6 days.
J. McH.	Chronic recurring.	48 hours.	6 days.
J. C.	Acute exacerbation.	5 days.	5 days; died; yellow atrophy.
J. W.	Chronic recurring.	1 day.	4 days.
J. B.	Perityphlitic abscess.	4 days.	32 days; two operations.

Of the twenty-nine patients in the hospital, eight remained more than one week, twenty remained less than one week, and one died of acute yellow atrophy of the liver. Of the eight patients that remained more than one week one suffered of a diffuse peritonitis with extensive drainage, two of perityphlitic abscesses with drainage, two had accidental wound infection, and one remained thirty-seven days in a free bed on account of hysteria. Thirteen were out of bed in forty-eight hours or less, and six stayed in bed more than a week.

APPENDICECTOMY OF THE ADHERENT APPENDIX WITHOUT ABSCESS

The adherent and buried appendix is found in two conditions. In the first instance it is covered in by old adhesions or is buried as the result of errors in embryonal development. In the second instance it is surrounded by recent inflammatory adhesions, com-

posed of the greatly thickened periappendicular peritoneum and the peritoneum of the viscera to which it is attached. In any instance it is recognized by the cartilaginous hardness of the chronically or acutely inflamed appendix, and its removal is complicated only by the difficulty of ligating the mesentery and amputating the appendix at its base. The cecum and the appendix itself are held so fast to the dorsal abdominal wall, that it is difficult to bring them into the wound. In many instances of an acute exacerbation of a chronic appendicitis the wall of the appendix is surrounded by a layer of thick, gray lymph, which is doubtless infected with the colon bacillus. Some of these cases, at least, if allowed to progress would result in perityphlitic abscesses. The size of the appendix varies greatly in these instances; sometimes it is small, hard, and its lumen is almost obliterated, and again it is thick, fleshy, and the lumen contains a small quantity of bloody pus.

The removal of an adherent or buried appendix without abscess formation requires the greatest experience and the utmost skill. The laparotomy is made in the same manner as for the free appendix. The search for the appendix is made with the index finger and the condition discovered. The appendix itself is carefully sought for by separating the head of the cecum from the lateral abdominal wall and discovering the buried base of the appendix, which is then slowly and carefully enucleated toward its tip. The thick, erectile appendix is usually recognized without difficulty by the tip of the index finger, and its adhesions are not often so strong as to require the

use of an instrument. As soon as a sufficient portion of the appendix has been detached to allow the application of an artery forceps, the base of the appendix is grasped permanently with the forceps, the index finger removed, the pelvic and ileocolic fossæ protected with narrow gauze sponges, and the remainder of the enucleation done in the open wound. Frequently the appendix can be torn away from its mesentery without the use of much force and without any considerable hemorrhage, but at other times it is necessary to apply forceps to the mesentery and cut away the appendix. Sometimes the appendix is so infiltrated and so nearly gangrenous, that it breaks loose with the first effort at enucleation, and is torn away with the first application of the artery forceps. This is a matter of little danger if the general peritoneal cavity has been properly protected with two or three narrow sponges. Occasionally the lymph glands in the mesentery of the appendix are greatly enlarged, and would suggest a malignant disease, or at least tuberculous adenitis (v., page 120), and if any attempt is made to enucleate them disastrous results may follow. Indeed, the presence of these enlarged lymph glands is positively indicative of long-continued and serious appendicitis; they disappear very promptly after the removal of the primary cause. Occasionally the appendix is so firmly buried and bound down that the base of the appendix cannot be brought into the wound, and the distal portion of the appendix can with difficulty be separated from its mesentery. A properly curved forceps can then be applied to the mesentery, and a second short, straight forceps can be

applied to the base of the appendix over the obliterated valve of Gerlach, their handles tied together with silk, and the appendix cut away. When the appendix can be enucleated and its base brought into the wound, it can be amputated in the same manner as the free appendix; but the denuded gut cannot, as a rule, be covered in with uninjured peritoneum. The stump is inverted, and one or two rows of Lembert sutures are laid over this inversion. There is rarely any hemorrhage requiring ligation. Simple compression of the bleeding points with large, strong artery forceps for three or four minutes is generally sufficient. I am accustomed to use a standard, straight and curved artery forceps six inches long and made unusually heavy and compact, Fig. 34.

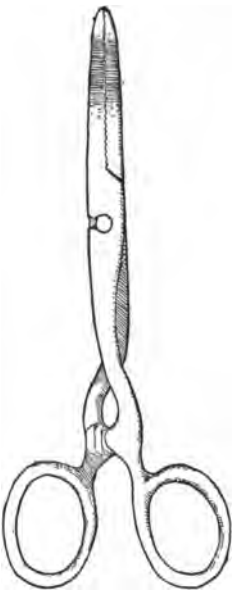

FIG. 34. The general outline of the six-inch artery forceps most useful in appendicectomy. A similar forceps curved on the flat is also used.

All of the maneuvers described in the preceding paragraph can be performed without difficulty through the inch or the inch and a quarter incision. The two or three narrow sponges are left in the wound, and everything is sponged out perfectly clean until no considerable oozing remains. All the sponges used must be absolutely moist and hot. While sponging is going on the index finger is kept constantly on the

denuded surfaces from which the appendix has been enucleated, and this index finger is used as a retractor and a guide to the hot sponge applied with the artery forceps. The withdrawal and reintroduction of the index finger is avoided. It usually remains in the wound from the beginning to the end of the operation. The last stage in this operation consists in the application of a liberal antiseptic tampon, composed of several strips of rolled antiseptic gauze. The first strip of gauze is carefully laid against all the denuded surfaces under the watchful index finger and firmly held in place. The second strip of gauze is thrown over the head of the cecum into the retrocecal fossa and folded back and forth over the first piece. The third piece of gauze is forced downward against the sponge, which is still protecting the pelvic fossa, and folded back and forth under the index finger. The fourth and last piece of gauze is thrown over the other pieces into the ileocolic fossa. The two or three narrow gauze sponges are now withdrawn while the tampon is held firmly dorsad with the ever watchful index finger. Great care is taken at the last moment to prevent the omentum from coming into close contact with the pedicle of the tampon and the wound. The four strips of gauze are at last carefully folded so as to completely fill and distend the small incision, and still hang two or three inches beyond the cut edges of the skin. If the small incision has been made, no sutures are necessary, and the operation is completed by the application of a large absorbent dressing. There is no doubt that iodoform gauze is extremely advantageous in cases of this kind, and it would

always be used but for the fact that some patients show a remarkable susceptibility to iodoform poisoning. This idiosyncrasy can never be foretold, and the results of iodoform poisoning are so serious and alarming, that iodoform gauze must be used with the greatest caution. Gauze filled with boric acid and sterilized, or treated with aristol instead of iodoform, or even gauze strips which have been simply sterilized, is preferable for a large tampon. When the artery forceps are left upon the stump of the appendix and upon the mesentery, the tamponade is made in the same manner about them, and they are excellent guides in the application of the tampon.

The subsequent treatment of cases requiring the tamponade is extremely simple. At the end of each six hours a glycerin and magnesium sulphate enema is given to encourage the discharge of gas and the emptying of the colon. The patient may sit up for these movements of the bowels, and as soon as the nausea has subsided he can begin to take liquid nourishment. The wound requires frequent changes of the absorbent dressing, and at the end of twenty-four hours the artery forceps may be removed and the four strips of gauze carefully loosened so that the portions folded into the wound as far down as the peritoneum are straightened. No irrigation is necessary or desirable. There is usually a very copious discharge of serum in the dressings through capillary attraction. At the end of forty-eight hours the two last applied of the four strips of gauze may be removed. The removal is made easy and less painful if the index finger is passed through the abdominal wall and the tampon gently

depressed during the withdrawal. By the end of the fourth day the tampon should be completely removed if it was properly applied, and this ought to have been done without the use of any considerable force and without producing much pain.

No further tamponade is necessary. The external wound should be kept open with some antiseptic gauze until the peritoneal opening has completely closed. Sutures are unnecessary, and there is little or no danger of hernia. After the peritoneal wound has closed, the skin can be more perfectly coaptated by the use of antiseptic adhesive straps. As a rule these cases are out of bed by the end of a week, and remain in the hospital only a little longer than cases in which the appendix is found free. There is no danger of a hernia if the incision was properly made and not too long.

The following case illustrates my experience with the buried, quiescent, and the adherent, inflamed appendix:

During the past summer I operated upon a patient twenty-six years old in whom I found one of the rarer traces of the excursions of the cecum, and one of the more difficult positions from which the appendix must be removed. He was an artist in my employ, and a perfectly healthy, strong young man. He had suffered two attacks of inflammation of the bowels, one of which kept him in bed for two weeks. He had been at work for me for a couple of months, and as a part of his preparation for surgical drawing he attended all of my operations at the hospital. One night an emergency operation for a periappendicular peritonitis was performed in his presence. He was very much impressed by the history of the case, and the dangerous condition in which the abdomen was found. On the following day he insisted upon the removal of his own appendix.

The ordinary examinations were made, and everything found perfectly normal except a moderate leucocytosis. After the routine preparation he was anesthetized with chloroform and the cecum approached by a vertical incision on the outer border of the right rectus an inch and a half long. There was no evidence of the old inflammation about the cecum; the cecum itself was short, reaching only a trifle below the ileocecal valve; the mesocolon was indistinguishable, if not absent. The mesocolon of the ascending colon was broad; that is to say, the colon from the cecum cephalad was sessile. The ileocolic and ileocecal spaces were empty and contained no appendix, but immediately behind the cecum, and ascending cephalad behind the ascending colon, and wholly covered by the two layers of the mesocolon, was a firm, hard, finger-shaped mass reaching cephalad to the kidney. This was carefully dissected out, and proved to be the appendix. It was thick, inflamed, and wholly destitute of a peritoneal covering except at its juncture with the upturned cecum. The cavity from which it was removed was packed with iodoform gauze, which hung out of the small incision. This gauze was removed upon the third day, and the patient left the hospital one week after the operation.

In my opinion this was a case in which the belated appendix had been caught behind in the retrocolic space and buried by the adhesions which occurred in early fetal life between the kidney, the abdominal wall, the colon, and the upturned appendix and cecum. This excursion is shown in the accompanying four diagrams from Huntington, Fig. 35.

APPENDICECTOMY OF THE FREE OR ADHERENT APPENDIX WITH ABSCESS

The most difficult appendicectomy is that which is necessary when an abscess has formed about the appendix. To open and drain an intraperitoneal abscess, whether it arises from the pelvis, from the

appendix, or from the gall-bladder, is difficult enough under any circumstances, but it is particularly difficult when it is connected directly with an inflamed and permanently infected diverticulum of the gut and filled with the putrefactive bacteria as well as with pus producing microörganisms. Nevertheless, this is the condition under which most beginners allow them-

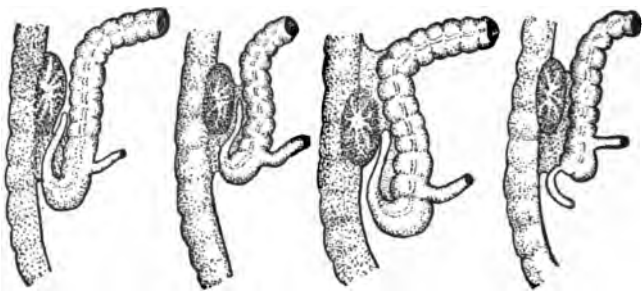

Fig. 35. Four positions of the appendix in the retrocecal mesentery. After Huntington.

selves to be corralled into operation. Either through the pernicious advice of the empiric, or through the natural hesitancy of inexperience or cowardice, not to mention baser motives or influences, the disease has been allowed to progress for one, two, three, or four days, or one, two, three, or four weeks, with lavage and enemas and boric acid poultices, until the pouting abdomen cries for the knife. The patient himself or the patient's friends insist upon some definite and rational procedure. At no time during the course of an appendicitis is appendicectomy so difficult, so dangerous, and so fraught with probabilities of future disaster. The experience of the majority of practitioners has to do with this form of appendicitis alone,

and many communities think of cases of appendicitis which have been neglected until the formation of periappendicular abscesses whenever the word appendicitis is used. Worse than this, they associate the operation for appendicitis with cases in which abscesses have formed, peritonitis has produced obstruction, and fecal vomiting has set in. Our medical ancestors spoke of puerperal fever with unblushing frankness. Many medical men speak of perityphlitic abscesses occurring "under their watchful guidance" in an equally unblushing manner. The one is no more a discredit to the practitioner than the other. Twenty years ago most operations for appendicitis were performed in this stage of the disease, but to-day every case of appendicitis with periappendicular abscess or infection must be looked upon as a neglected or complicated disease.

When a periappendicular abscess has formed, it may sometimes be reached by an incision through the abdominal wall without opening the general peritoneal cavity. More often, however, the parietal peritoneum must be incised and the abscess surrounded with sponges, an opening made in the presenting wall, and the pus mopped out. Then begins the search for the offending appendix under conditions most difficult to meet and most dangerous to the patient. The wall of the abscess is often the thickness of the palm, and it involves tissues which cannot possibly be recognized by palpation. The ureter may pass through the dorsal wall of the abscess, or the iliac vessels may be covered by the pendant appendix. If the appendix is found in the bottom of an ileocolic abscess, its removal may

destroy a branch of the superior mesenteric artery, and gangrene of a portion of the ileum result. Therefore, any manipulation for the removal of the appendix must be of the most careful sort, and nothing except the most obvious and easily accessible appendix should be tampered with in the abscess wall. When the finger has been passed three or four times around the abscess cavity, and the appendix remains undiscovered, or even when it is found intimately buried in the abscess wall, further attempts at its removal should be abandoned. The cavity after the most strenuous disinfection should be packed with iodoform or other antiseptic gauze strips at the end of the index finger, to be brought out through the incision. This may sometimes be done so as to involve none of the healthy peritoneum. The protecting sponges should then be removed and the abdominal incision reduced by sutures to an inch or an inch and a quarter in length. The strips ought to hang out of the incision for two or three inches, and when the abscess cavity was originally very large, it may be desirable to facilitate drainage by the introduction of a half inch pure gum drainage tube, surrounded by the gauze strips.

The wound should be covered with a large antiseptic absorbent dressing and the patient treated the same as if he had an adherent appendix without abscess. The patient must necessarily be kept in bed a longer time on account of the more extensive incision required, and he must be promised the second operation at the end of four or five weeks when the abscess cavity has been reduced to a minimum and the abscess wall so absorbed and removed as to permit

of an appendicectomy. This second operation is practically the same as that described in the preceding section of this chapter. On page 40 a case of this kind is narrated.

When a periappendicular abscess has been drained and the appendix removed, the patient cannot be pronounced sound and well. If he escapes a fistula, a hernia, and a painful scar, he may have suffered irreparable damage to his ureter, or dangerous adhesions may have permanently inhibited the normal peristalsis of his intestines. The omentum or more distant viscera may have become intimately attached to peritoneum which formed part of the abscess wall, and torts of the hollow viscera may result, or deformities which impede and mechanically interrupt the competency of essential organs of digestion. In women the uterus or the tube may be involved in the adhesions, and as a result of deformity of the tube an extrauterine pregnancy may occur. The perityphlitic abscess which was opened may not be the only one, and weeks, months, or even years afterwards another abscess may show itself as the adequate and unsuspected cause of a protracted invalidism. It is a laborious task, it is a tiresome undertaking, it is an exasperating procedure, it is a disgusting job, to recount the dangers which the physician invites when he coaxes appendicitis by lavage, enemas, and poultices into the formation of a periappendicular abscess.

In draining large periappendicular abscesses the method of applying the tampon or instituting the drainage is often a question of great importance. Tubular drainage is very effective in cases where it

can be applied, but in irregular abscesses it must be supplemented at least with drainage by strips of gauze. The handkerchief or Mikulicz drain requires an incision too large for most of these cases, and strips of antiseptic gauze have been found most serviceable. They are so prepared that the raw edges are turned in, and the strips are impregnated with boric acid, aristol, or iodoform. As a general thing iodoform would be preferred were it not that it is occasionally absorbed and produces severe poisoning.

That the danger of iodoform poisoning is a real one is illustrated by the following case:

J. M., 17 years old, was a well-developed and perfectly healthy girl except for occasional attacks of abdominal pain, which she had suffered as long as she could remember. On Thursday afternoon, April 14th, she was taken with severe abdominal pain after running and playing. During the evening she had excessive pain at the pit of the stomach. She slept occasionally during the night, and was about the house on Friday. A physician was called Friday morning, who pronounced the case appendicitis and recommended operation. Saturday and Sunday her bowels moved freely. Saturday morning the pain became worse, and continued with occasional vomiting until Monday morning. Some time during Sunday night or Monday morning she had a pronounced chill and rigor. Dr. Joseph P. Jones saw the little girl shortly afterwards, and insisted upon her removal to the hospital. I saw her at seven o'clock in the evening. Her temperature was 100, her pulse 88, respirations 22. She had had a bowel movement and had passed much gas. She was found to be menstruating. The abdominal muscles were excessively rigid, and a large, tender, and palpable tumor was found in the right iliac region. She had a marked leucocytosis, and the urine was free from abnormal constituents. An hour later she was operated upon by me with the assistance of Dr. C. G. Goodwin and Dr. Charles G. Davies. She was anesthetized with

chloroform, and the abdomen opened on the outer border of the rectus with an incision an inch and a quarter long. Free pus came into the wound at once, and the presenting loops of small intestine were covered with grayish white flakes of fibrin. This presenting gut was at once grasped in a loose forceps and held over the median side of the wound. The finger was insinuated downward along the mesentery into the ileocolic fossa, where the appendix, firmly adherent in all directions to the mesentery of the ileum and the wall of the colon, was enuncleated. It was surrounded with thick, gray pus and flakes of fibrin. The mesentery of the appendix was ligated, the appendix brought into the wound and removed in the usual manner. The cavity from which the appendix had been enucleated was filled with strips of iodoform gauze, completely distending the ileocolic fossa. Pus was found in the pelvic fossa, and after it had been sponged out the pelvic fossa was packed with other strips of iodoform gauze. The head of the cecum was also covered with the same material, and the six or eight strips of gauze lightly packed into the incision so as to promote drainage. The tamponade was very extensive, amounting to as much as the bulk of two clenched hands. The gauze itself was very liberally impregnated with iodoform, which had been emulsified with glycerine.

After the operation her rectal temperature was 100, her pulse 96, and respirations 22. She complained bitterly of thirst during the night, and cracked ice was given freely by the mouth and normal salt enemas were given by rectum and retained. She did not sleep at all during the first night, and vomited a little. In the morning her temperature per rectum was 100.2, her pulse 100. Examination of the urine showed a trace of albumin and a few hyalin and granular casts. Eight ounces of magnesium citrate in divided doses were given, followed in two hours by a high enema. The water was passed from the rectum clear and uncolored. During the afternoon she slept very well. In the evening low enemas of magnesium sulphate, glycerine, and water were given. They were followed by the discharge of mucus and gas. A grain and a half of calomel was given in divided doses, followed by a high enema. This resulted in a good movement of the bowels. She complained very little

during the night and slept fairly well. Her temperature during the night remained at about 99, her pulse between 90 and 100. She retained water and some milk, but towards morning vomited again. In the afternoon of Wednesday, the second day after the operation, her temperature was 99, her respirations 22, but she vomited often, her pulse had risen to 114, and she seemed to the nurse somewhat delirious. Examination of the urine showed a specific gravity of 1013, urea 1.9 per cent, a slight trace of albumin, and about one hyalin cast to every two fields. The urine was at all times in sufficient quantity. During the night much flatus was expelled, and she had a good bowel movement; she did not rest well, and drank freely of water; her pulse remained between 95 and 100, and her temperature between 98.4 and 99. On the morning of the third day part of the gauze which was packed lightly in the wound was removed. Cream and water were given quite freely during the day and retained, but the patient did not sleep well, and seemed very restless. At eight o'clock in the evening her pulse had reached 110, her temperature was 99, respirations 22. She slept quite well during the night, and towards morning expelled much flatus. During the morning of the fourth day her pulse gradually rose from 100, and at two o'clock in the afternoon had reached 120, temperature 99.4. Her pupils were dilated and reacted very slowly to light. She seemed quite delirious, and cried out often as if in great pain. She had an involuntary bowel movement. Examination of the urine showed a good quantity, specific gravity 1018, albumin, and an average of one hyalin cast to each field. She passed a great deal of gas by the rectum, and the abdomen was not distended or excessively tender. She complained of difficulty in swallowing, and the nurse noticed muscular twitchings and jerking of the body. At ten o'clock that night her pulse had reached 130, her temperature 100.6, her respirations 20. An examination of the blood showed 12,800 white cells to the cmm. An examination of the urine showed many hyalin casts, but only a trace of albumin. The quantity of urine was abundant, the specific gravity 1018. On the morning of the third day, when the first gauze was removed, it was noticed that all of the discharge from the wound was filled with iodo-

form. On the suspicion that the delirium and rise of pulse was due to intoxication with iodoform, I withdrew the gauze as rapidly as I thought advisable, so that on the evening of the fourth day several strips had been withdrawn from the abdomen. I then introduced plain sterile gauze strips and mopped out the cavity thus made as dry as possible, after which I packed the wound with plain gauze. I ordered that she be given forty grains of sodium bicarbonate and plenty of water during the night. She was very delirious all that night, and her pulse at 4:30 in the morning was 160, weak and irregular; her temperature was 101.4; her respirations 18. Her pupils were widely dilated. She passed a great deal of gas by the rectum, and passed large quantities of urine. Examination of the urine showed a trace of albumin, many hyalin casts, but repeated tests gave no reaction for iodin. During the morning she was given a hot pack for twenty-five minutes with an ice-cap applied to the head. She reacted well to this, and perspired quite freely. An eruption rapidly appeared over the chest and back. Her pulse at noon of that day was 134, her temperature 103.4, respirations 32. During the afternoon she had an involuntary bowel movement, and at four o'clock her temperature had risen to 104.2, her pulse was 138, respirations 28. I ordered a cold sponge for temperature, and within three hours her temperature had dropped to 102.4, her pulse was 127, her respirations 24, and she was somewhat brighter, and seemed able to understand what was said. All of the gauze had been removed by this time, and I had repeatedly mopped the wound out with dry plain gauze and gauze wrung out of a weak solution of lysol. The wound was now irrigated with normal salt solution poured from a pitcher. She had a very fair night, and the next morning, Sunday, the sixth day, her pulse was 104, her temperature 101.4, respirations 22. There was at this time noticed a yellowish secretion from the vagina, for which condition lysol douches were given every four hours. An examination of the urine showed a very yellow urine, of a specific gravity of 1020, containing no albumin and very few casts, but giving a good iodin reaction. The patient had a good bowel movement without enema, and the abdomen showed no distention. The wound

was again irrigated with normal salt solution and repacked with plain sterile gauze. Cream, milk, and water were given during the day in large quantities, and the patient felt quite well. Her temperature did not go above 102, and her pulse remained between 100 and 110. During the night she slept quite well, and her pulse dropped to 90, her temperature was 100.4, respirations 20. Before midnight she had quite a severe nose-bleed. On the following morning, the seventh day, she had several good bowel movements; an examination of the urine showed a few hyalin casts, with a trace of albumin; her pulse was 92, her temperature 99.4. During the day her pulse did not go above 105, and her temperature not above 100.

Her history from this day was uneventful. She made a rapid recovery, and left the hospital on May 16th, four weeks after admission to the hospital.

There is no time in the course of an infection from appendicitis when the life of the patient should be entirely despaired of. The most extensive complications terminate in relative recovery. The following case contains many lessons, and shows the result of persistent, courageous, and effective surgery. I would personally criticise the first delay, but otherwise approve of the hard-fought battle of my colleague:

"The patient was a woman who had not had a previous attack. She suffered from severe pains in the abdomen, with vomiting and fever, for a week, but kept on doing her housework. She finally called in a physician on the seventh day after the onset of the attack, because at this time she suddenly had most severe pain in the right iliac fossa, radiating all over the abdomen, but chiefly focused in the right iliac region. This was accompanied by high fever, vomiting, and collapse. Dr. William Hessert saw the patient on the seventh day, the case having been referred to him by Dr. W. W. Breringer. Her pulse at this time was 106, temperature 104, and she was in a collapsed condition. The abdomen was tender; nothing definite could be made out except a point of

tenderness in the right iliac region a little interior to the anterior superior spine. A diagnosis of perforative appendicitis was made, but her condition was such that it was not deemed wise to operate at once.

"He therefore instituted the treatment advocated by Ochsner, namely, withholding food, gastric lavage, giving no opiates or cathartics, etc. The patient was much better the next day, in that the pulse had declined to 120, and temperature to 102. He then operated, and found that the appendix had ruptured, with a concretion in the free peritoneal cavity not far from the appendix. Some free pus around the appendix. The appendix was posterior to the colon, lying on the iliacus muscle, and was removed with difficulty, owing to the shortness of its mesentery. It was removed, and the stump inverted with fine silk suture. Drainage with gauze and rubber tube. After the operation the patient left the table in good condition. But for the first week following the operation her temperature did not decline; it ranged from 101 to 103. While her general condition had improved, she still had pain, which became localized in the lower lumbar region, so that an examination showed the development of a mass anterior to the kidney and below the liver, and probably behind the colon. On the seventh day after the operation there was a profuse discharge of pus from the original wound, and by making a bimanual palpation over the lumbar mass, pus exuded from the operation wound. She was taken to the operating-room, and a lumbar incision made similar to the Simon kidney incision, and a large amount of pus evacuated. There was considerable granulation tissue which had broken down, and several abscess cavities were evacuated. Even after this the patient's temperature did not decline. The abscess was not entirely retroperitoneal however, as the border of the liver was visible. That night her temperature was 105, and her pulse very much accelerated. Within the next ten days she got along fairly well, and the wounds drained nicely, large amounts of slate-colored pus escaping. Later, patient developed shortness of breath, accompanied with a hacking cough. Dullness developed in the right lower chest, over which region the respiratory sounds were absent, with the other physical signs of fluid. Exploration showed the presence of pus, so that on the twenty-

seventh day after the first operation the ninth rib was resected in postaxillary line, and considerable fetid pus removed. The patient's temperature that night rose to 106, pulse 140. She had lost weight, and was almost reduced to skin and bone. She was in a typically septic condition; but she was stimulated and fed, and she rallied, and was getting along fairly well, running a septic temperature, although the short hacking cough continued. Ten days later she suddenly coughed up about a cup and a half of fetid pus, showing that she had had an abscess of the lung, which had ruptured into a bronchus. She collapsed, and it was thought she would die; but after swaying in the balance for two or three days between life and death she finally rallied and got along fairly well again. All this time her pulse ranged from 120 to 160; temperature ranged from 102 to 106. Two weeks after this, there being considerable dullness of the right lung, and it being difficult to diagnose the exact condition, owing to the thickened condition of the pleura and partial consolidation of the lung, the resection wound having previously healed, and cavity having granulated up, the upper right chest filled with pus again, the heart displaced to the left side, left chest practically negative, so an aspirator was inserted into the sixth right interspace in anterior axillary line, and pus was discovered. Under Schleich anesthesia Dr. Hessert did not resect a rib, but went through bluntly and inserted a tube, evacuating a large amount of pus. This abscess cavity was distinct and separate from the previous cavity. The patient was exhibited well and strong, having regained all of her former weight. To summarize, there was a perforation of appendix on seventh day. Appendicectomy and drainage next day. Twelve days later lumbar abscess drained. Fifteen days later empyema of same side drained by resection of rib. Ten days later pulmonary abscess on same side coughed up. Fifteen days later another empyema higher up was drained."

The most unexpected conditions are found when the disease is allowed to drift on under the shadow of a liberal administration of opium, even after only two or three days of expectant treatment. In one case, for example, forty-eight hours after the beginning of

noticeable symptoms, and after only twelve hours of vomiting, the periappendicular region was found full of fecal matter, the appendix was almost completely separated from the gut by a perforation over a coprolith, and the pus bubbled out with a liberal amount of gas which had escaped from the bowel. During the attempt at appendicectomy the appendix became unexpectedly detached both from the gut and from the mesentery and was almost lost in the peritoneal cavity.

The inability of the physician to operate and the difficulty of getting an operator of sufficient experience on short notice encourages a tendency to try expectant treatment of appendicitis. It also encourages careless habits of diagnosis, especially in differentiating between the different stages of this disease.

The competition between unscientific and unprofessional physicians sometimes encourages expectant treatment. If the conscientious physician has made a diagnosis of appendicitis, and believes that appendicectomy offers the safest course and the only method of recovery, he may be deterred from recommending operation by the fear that the family or the patient may refuse treatment, and this patient may make a temporary recovery without operation in the hands of his unscrupulous rival, and for the time being greatly to his own embarrassment.

It is only after several disastrous experiments with expectant treatment, and after several victories in recommending operation, though for a time losing the confidence of patients who ignorantly choose the long-suffering method in the hands of blatant and unscrupulous rivals, at last compelled to confess their errors

by following the course first recommended, that the physician with a scientific conscience and a human heart has the courage to stand up for his convictions and adroitly and sympathetically insist upon appendicectomy. It is only after a case of appendicitis terminates in death under his guiding eye less than twenty-four hours after the appearance of the first symptom; it is only after he has lost a patient with a periappendicular abscess, and seen him get up and go miserably about for a month, and then die after an operation for general peritonitis at the hand of his rival—that he is able to lay aside all considerations of temporary policy and economic diplomacy.

After the appearance of peritonitis, and presumably of periappendicular abscess, any transportation of the patient becomes dangerous. The danger is probably less after days or weeks have passed and the adhesions have become firm. Patients have been known to carry such abscesses about with them for weeks or months until through some unusual strain the abscess ruptures and a general peritonitis or an extensive diffusion occurs.

When a patient is some distance from a hospital, and in the early stage of periappendicular infection, the question of transportation is a serious one in which the convenience of the operator should never weigh against the safety of the patient. The advantage in securing the unusual facilities of a well-equipped operating room is small as compared with the risk of disseminating the periappendicular infection.

APPENDICECTOMY COMBINED WITH OTHER OPERATIONS

On account of the very general disease of the appendix, most operators are accustomed to remove this retrogressive part whenever access is given to it in operations for other purposes. Nearly all median laparotomies give access to the appendix, and it can be removed in a perfectly typical manner through a small median incision.

The appendix frequently appears in herniotomy upon the right side, and under such circumstances it can be removed through the incision in the inguinal ring without adding in any great extent to the risk or the duration of the herniotomy. It must be removed when the appendix has become fast in the hernial sac, or when a periappendicular abscess has developed in a hernia.

Appendicectomy is readily accomplished in many cases where cholecystostomy is necessary. It is not necessary to lengthen the incision for this purpose.

Appendicitis and displacement of the right kidney are very often coincident if not cognate conditions. The lumbar incision through which the kidney is approached and fastened into its place gives access to the appendix, and it should be examined and removed if desirable.

THE TREATMENT OF DIFFUSE AND GENERAL PERITONITIS FROM APPENDICITIS

The treatment of diffuse peritonitis after appendicectomy when it is limited to the immediate periappendicular peritoneum does not differ materially from

the treatment of the appendicectomy of the adherent appendix with abscess. The whole question of drainage in diffuse and general peritonitis involves so many questions and conditions, that it is treated in a following chapter.

THE TREATMENT OF FISTULA AFTER THE DRAINAGE OF PERIAPPENDICULAR ABSCESSES

A fecal fistula consists essentially in a sinus leading directly from the gut toward the abdominal wound, the walls of which sinus are covered with mucous membrane. In the majority of cases the mucous membrane of the appendix itself lines the larger portion of this channel. It is partially shut off, sometimes completely shut off, from the cecum by the obliterated or partially obliterated valve of Gerlach. When the sinus is directly connected with the cecum, there is usually some destruction of the function of the cecum so that one of the haustra tends to empty itself into the sinus rather than into the ascending colon. This is due either to adhesions limiting the activity of the cecum or to the absolute deformity or destruction of the muscular elements.

The treatment of these fistulas is expectant, and after all patience is exhausted, one of the most complicated surgical procedures. It presupposes the obliteration of all of the mucous membrane lining the sinus and the closure of the opening into the cecum. When there is a defect in the cecum or ascending colon, it contemplates the repair of this defect.

These simple indications are extremely difficult of accomplishment. Usually there is a considerable

defect in the abdominal wall, a hernia, or a loss of muscular elements through suppuration and necrosis. As many as five or six distinct fistulas may penetrate the skin and fascia in the right iliac region. It is usually well to put the patient who has suffered prolonged suppuration into as good condition as possible by forced feeding, out-of-door life, and the lapse of sufficient time to permit the thickened peritoneum to become absorbed. After the integrity of the kidneys has been established and the condition of the patient permits, the intestinal tract is emptied as thoroughly as possible, the field of operation is made clean, and the sinus is filled with a catheter or director and carefully dissected out through a liberal abdominal incision. As the fistulous tube is separated from the surrounding skin with the inclosed guide, it is covered with antiseptic or sterile gauze, and at last the peritoneal cavity is opened and the fistula, which may or may not be composed in part of the remnants of the appendix, is followed to the cecum. The cecum is detached from its adhesions to the ventral abdominal wall, and the sinus removed the same as if it were an appendix. The destroyed or paralyzed and raw surfaces of the colon and cecum unite very badly, and the utmost pains must be taken to turn in the opening from which the sinus was removed with several rows of Lembert sutures. An effort should be made to turn in completely the raw surfaces of the colon and get fresh peritoneal surfaces together in the last Lembert suture. If the operation has been done without contaminating the wound or peritoneal cavity, the abdominal wall may be completely closed with three or

four layers of sutures, beginning with the peritoneum and ending with the skin. It is safer as a rule to introduce drainage, either through a new incision or through the end of the primary incision.

When there are many fistulas penetrating the abdominal wall, it is often necessary to make repeated operation; first bringing the divided delta of filth into a single stream, and then treating that stream as described above. So much of the abdominal wall is frequently destroyed by the progress of the suppuration that a plastic operation upon the abdomen is necessary. This is at times extremely difficult because the patient has grown fat since the closure of the abscess and the establishment of the fistula, and the tissues of the abdominal wall have retracted, leaving an enormous defect and scar. Each case of this kind is a study in itself, and merits more reproach to the physician under whose guidance it has originated than credit to the surgeon who is ingenious enough and skilful enough to close it.

THE ANESTHESIA FOR APPENDICECTOMY

There are three forms of anesthesia which are sometimes necessary in appendicectomy: (1) local anesthesia with Schleich's solution; (2) nitrous oxide gas anesthesia; (3) chloroform or ether complete anesthesia.

1. In any thin and self-controlled individual, with a free appendix, appendicectomy can be performed safely and comfortably under Schleich's solution and local cocain anesthesia. The preparation of the

patient is practically the same as if a general anesthetic were to be given. Vomiting rarely occurs, and this form of anesthesia is available when the stomach is full. Alcoholic stimulants can be given during the procedure. The patient receives a quarter of a grain of morphine hypodermically immediately before the final scrubbing of the abdomen; as soon as the scrubbing is finished, and at least ten minutes after the hypodermic was given, the skin over the proposed incision and the subcutaneous fat is infiltrated with the most dilute Schleich's solution. This solution is made as follows:

Muriate of cocain . . .	0.030
Sulphate of morphin . . .	0.200
Normal salt solution . q.s.	100.000

M. Sterilize.

This solution is used with two or three small sterile hypodermic syringes, which are kept full by the assistant and injected from time to time when the patient complains of pain. The abdominal wall can be incised without the slightest sensation of pain until the parietal peritoneum is reached. A small tampon, as large as the end of the index finger, should then be saturated with a ten per cent cocain solution and squeezed out. This tampon should be forced firmly against the parietal peritoneum for thirty seconds. The peritoneum can then be picked up and incised with trifling pain. The little tampon is again saturated and squeezed out, and the parietal peritoneum around the incision is mopped over with it three or four times slowly and gently. This will produce some

pain, but it will give great relief to the patient during the exploration in search of the appendix and in the subsequent manipulation. No cocain solution is necessary during the ligation of the mesentery or the removal of the appendix. There is little or no sensation in the visceral peritoneum or in the appendix itself. The greatest pain is suffered during the introduction of the skin sutures. If a short incision has been made, two or three silkworm gut stitches will be sufficient.

Local anesthesia is equally applicable to cases in which the appendicitis has been neglected and edema of the abdominal wall shows that an abscess can be opened without opening the general peritoneal cavity. It is also very serviceable when nephritis, bronchitis, old age, or excessive obesity contra-indicate a general anesthesia.

The only complication which is encouraged by the local anesthesia is infection in the edematous tissues through which the incision is made. This applies practically to the skin. If too strong a solution is used, the patient may become intoxicated with the cocain.

Cocain anesthesia may be used in incising the abdominal wall, and difficult abdominal manipulation performed under gas or with a few whiffs of chloroform.

2. Since the introduction of compact and portable nitrous oxide apparatus into the daily equipment of the dentist's office and the operating-room, this means of anesthesia can be used for a short operation such as appendicectomy of the free appendix. The prepa-

rations are made the same as for any other anesthetic, and should complications occur, necessitating the use of a prolonged anesthtic, ether can be administered and the operation completed. The gas is contained in liquid form under great pressure in small portable, iron cylinders. It is allowed to escape into a large guttapercha bag, from which it passes to a valved inhaler, where it is given in any degree of concentration required. The art of administration is readily learned, and there is little danger of accident. The anesthesia produces a turgidity of the face which is quite alarming, but the administration of a little air quickly aerates the blood, and the turgidity and anesthesia pass away. This form of general anesthesia can be kept up for twenty minutes or half an hour. With more complicated apparatus and the mixture of oxygen, a longer anesthesia is possible. The cost of a nitrous oxide gas outfit varies between $30 and $50.

3. The subject of general chloroform and ether anesthesia is one of such great importance that it cannot be discussed in this place. It is a fact which cannot be refuted, that in the hands of the average practitioner chloroform is more dangerous in producing immediate death than ether. Nevertheless, it is and has been my custom to use chloroform alone as a general anesthetic, but always in the hands of a thoroughly trained anesthetizer. My operations, moreover, are rarely longer than twenty or thirty minutes, and perhaps on this account an anesthetic like chloroform is less dangerous. In any case if a general anesthetic is to be given, the patient should be thoroughly prepared by emptying the stomach and intestinal

tract; the room in which the anesthetic is administered should be as quiet as possible, and the anesthetizer and patient should be in the utmost sympathy with each other. The anesthetic should be administered gently, but unhesitatingly, and as much hypnosis should be added to the anesthetic as the anesthetizer is capable of using. When giving chloroform I am accustomed to administer it drop by drop upon a handkerchief or the Esmarch mask, requiring the patient to count after me with each expiration. With the first full breath I put a few drops of chloroform on the mask and say "one." The patient replies "one" and expires in the act of vocalization. At the end of the next full inspiration I say "two," and the patient replies "two" and expires again. In this way the attention of the patient is engaged, and certain reassurance is carried from the anesthetizer to the patient, which allays dread and fear and encourages a rapid narcosis. Usually the anesthesia is complete at the end of thirty or forty inspirations, or at the expiration of about four to six minutes. With chloroform there is a slight waking up two or three minutes later, and more chloroform must be given. This first anesthesia, or little anesthesia, as it has sometimes been called, is long enough for the removal of an appendix through the abdominal incision, or the opening of an abscess.

The duration of an ether narcosis is generally longer. It takes more time to put the patient asleep and a longer time for the patient to wake up. Although there is less danger to the patient from sudden death when ether is administered, the chances of

severe pulmonary or renal complications are very great. Nephritis, pneumonia, and severe bronchitis follow ether narcosis much oftener than chloroform.

As a result of chloroform I have had one death on the table in eighteen years' practice. The outline of this case is as follows:

The patient was a woman suffering of a large ovarian tumor with twisted pedicle. The anesthetic was given by a stranger to me. I was operating in an unfamiliar operating-room and under rather trying surroundings. The patient was in the Trendelenberg position when I noticed asphyxiation. It was about five or six minutes after the beginning of the operation. The abdomen was quickly covered and artificial respiration performed. The asphyxia disappeared, the heart was beating; the abdomen was quickly closed under artificial respiration; the patient could not be depended upon to make a single effort at inspiration. Artificial respiration was kept up for an hour after the patient was put to bed. At that time she was profoundly asphyxiated, and the heart had stopped beating.

During the past two years I have had two deaths follow appendicitis which may or may not have been due to chloroform anesthesia. In both of these patients a complexus of symptoms was presented ending very shortly in death, and comparable only to acute yellow atrophy of the liver. Whether this degenerative process was already established, or whether it was the result of chloroform anesthesia, I am wholly at a loss to decide. Both patients were young women, one of them twenty-three years old, the other twenty-

six. Both were hard-working women, one was a trained nurse in the second year of her service, the other was engaged in office work, and had been under extraordinary strain. Both patients had suffered severe abdominal pain referred to the upper part of the abdomen, and in both cases it was almost as pronounced after the operation as before. In the case of the nurse the pain was most agonizing for three days before the operation, and had been paroxysmal for months; there had been a diarrhea the week before the operation, and the last paroxysm had lasted nearly twenty-four hours, and somewhat abated the day before the operation. In both cases I had the advantage of a blood count, and both patients had a moderate leucocytosis, 12,000 to 15,000. In neither case was there any evidence of nephritis or infection of the genito-urinary tract, and neither patient was or had been pregnant. Both patients were rather plump young women, and the nurse was specially sturdy and strong, though of moderate stature. The nurse was a blonde, and the office girl was a brunette. Neither of them had ever suffered of any disease which had left a trace or had required a stay in bed. In neither case were the stools clay-colored, and in neither case were leucin and tyrosin sought for or found in the urine. In both cases the delirium was inconsistent with the temperature and pulse, and in both cases the amount of jaundice was only moderate. In neither case was vomiting an early, conspicuous, or persistent symptom. The nurse vomited a few times before the operation, and was unable to retain anything upon her stomach. The office girl vomited profusely immedi-

ately after the onset of pain in her last attack, and again on the morning of the third day after her operation. In neither case was the appendix so obviously diseased as to explain the symptoms. In the case of the nurse the appendix was buried in the retrocecal fossa by old, inflammatory adhesions, while in the case of the office girl an appendix, which measured exactly six inches after its removal, hung free in the pelvic peritoneal cavity by a rather long mesentery. The pulse in the case of the nurse went up rapidly from the start, and was followed by very high temperature and complete suppression of urine during the last twenty-four hours. The pulse in the case of the office girl was rapid during the first three days, and went up suddenly with only a moderate temperature, no suppression of urine, and no evidence of nephritis to the very last. In both cases the operation was done in less than half an hour, and under the most rigid antiseptic precautions. Neither patient at any time showed symptoms of peritonitis, and in the case of the nurse the peritoneal cavity was proved at the necropsy to be sterile. The gall-bladder of the nurse was opened the day before her death with a suspicion of cholecystitis. No second operation was performed on the office girl. The nurse died at the end of the third day after operation, and six days after the beginning of the acute symptoms. The office girl lived five days after the operation. In the case of the nurse I had the assistance of Dr. Preble, who made repeated examinations, and urged operation thirty-six hours before I could bring myself to undertake it. In both cases I had the advice of Dr. Preble after the unfavor-

able symptoms showed themselves. In the case of the nurse a most painstaking necropsy was made by Dr. Wherry and Dr. Gideon Wells. A necropsy on the office girl could not be secured.

Dr. Wherry made the postmortem on the nurse, and I will condense his report:

The body was still warm when the necropsy was made. The epidermis and sclera were stained a lemon yellow. The operation wounds appeared healthy. The one at the site of the gall-bladder was open and draining. The abdomen was distended and tympanitic. The peritoneal cavity was free from fluid. There were a few fibrinous adhesions about the site from which the appendix had been removed. There was some hyperemia of the peritoneum in the vicinity of the gall-bladder operation. The blood flowing from the renal vein was noticeably dark. The consistency of the kidney was firm; the capsule stripped off readily; the cuticle markings were indistinct, and the glomeruli appeared as dark red specks. The perirenal fat was stained a greenish yellow. The gall-bladder was adherent to the wound and drained. There was no obstruction in the cystic or hepatic or common duct; no calculi. The spleen appeared practically normal. The liver was small, but reached nearly to the edge of the costal arch; firm in consistency, and bright yellow in color. Cut surfaces of the liver were oily and resembled fatty degeneration upon passive congestion and bile pigmentation. There were no hemorrhages or other visible alterations. The mesenteric glands were enlarged and congested, but there was no necrosis. The internal organs of genera-

tion seemed normal except for some small cysts in the left ovary. There was a corpus luteum of menstruation. The pancreas appeared normal except for an accessory spleen near its tail. The examination of the thoracic viscera was entirely negative.

Cultures from the liver remained sterile. Smears from the peritoneal surfaces were devoid of bacteria; scrapings from the liver examined in salt solution showed marked fatty degeneration and some cloudy swelling. The same changes were present in the kidney in reverse prominence.

Histology of the liver showed the most prominent change to be a marked central necrosis of the lobules. The cells of the inner two-thirds of each lobule had generally lost their nuclei, were smaller than normal, coarsely granular, and showed an increased affinity for eosin. The central capillaries were distended with blood, and there were many leucocytes both in the blood and among the liver cells. There were many minute fat droplets in the necrosed cells and fewer in the less altered cells of the periphery of the lobule. The biliary vessels were not altered, and there were no bacteria to be found anywhere. The central necrosis was similar to that seen in many intoxications, notably that of violent streptococcus septicemia, diphtheria, puerperal eclampsia, and the earliest stages of acute yellow atrophy of the liver. This condition apparently can be produced by many soluble poisons, whether of metabolic or bacterial origin, provided they reach the liver in sufficient concentration.

Dr. Wells remarked after examining the specimens that they did not represent a full-fledged yellow

atrophy, nor could one say positively what they might have become in the course of time. All that can be said is that there was a marked toxic effect upon the liver without demonstrable bacterial cause. The same appearance may be seen in acute yellow atrophy in its earlier stages, in eclampsia, and in the so-called chloroform necrosis of the liver.

CONTRA–INDICATIONS TO GENERAL ANESTHESIA FOR APPENDICECTOMY

No contra-indication to a general anesthesia is more common in appendicitis than acute nephritis. The presence of evidences of a chronic nephritis without an acute exacerbation is not a very strong contra-indication to the use of chloroform or ether for a reasonable length of time. An acute nephritis, however, is almost prohibitory, and even a short general anesthesia under such circumstances is a most dangerous proceeding. Unfortunately there are no measures which may be instituted to make the danger less threatening, but fortunately the operations which are required under these circumstances are simple and relatively easy. Most cases of extensive perityphlitic abscess are accompanied by a more or less pronounced acute nephritis. The abscess must be opened and drained; the condition of the kidneys prevents the use of a general anesthetic. The abscess may be opened with a Schleich infiltration. The toxemia then disappears, and with it the nephritis. The appendicectomy can then be performed under general anesthesia at a second operation.

A grave anemia due to protracted hemorrhage or to extensive suppuration is sometimes present when appendicectomy is indicated. A diminution of the red corpuscles below 2,000,000 and the hemoglobin index below 60 must always make a general anesthetic a matter of grave concern. Usually the suppuration is connected directly or indirectly with the appendix, but sometimes it is due to a tuberculous hip, or to empyema, or to protracted suppuration in the mastoid cells and middle ear. I once performed an appendicectomy and drainage of a large pelvic abscess in a tuberculous boy with sinuses opening in his thigh and back. He was excessively anemic, and had a low hemoglobin index, and yet he withstood a half-hour of chloroform and recovered splendidly.

Bronchitis, pulmonary tuberculosis, and severe lesions of the heart are relative contra-indications to the use of a general anesthetic, and especially to the use of ether. These patients can endure a very brief chloroform anesthesia, and they even withstand the asphyxiation of nitrous-oxide gas, but no extensive operation can be safely undertaken upon them.

Obesity is a relative contra-indication to the use of a general anesthetic, and especially to the use of ether. Such patients frequently become asphyxiated, and artificial respiration upon them is practically impossible. When tracheotomy is necessary in the midst of such an accident the neck is so fat and short that the introduction of a tracheotomy tube is a difficult procedure.

Chronic alcoholism and acute alcoholism are serious obstacles to the administration of a general anes-

thetic. These patients take the anesthetic badly, enormous quantities are required, but they recover from the anesthetic rather more rapidly than other patients.

Old age is a serious obstacle to a general anesthetic, especially when the arteries are hard and the integrity of the kidneys uncertain. Nevertheless many old people take a short chloroform anesthesia without much difficulty.

The presence of an enlarged tonsil, a goiter, or even a long uvula and an obstructed nares makes a general anesthetic more dangerous. The presence of a goiter is especially dangerous when the trachea has become somewhat atrophied through the pressure of the tumor.

Exophthalmic goiter in any advanced stage seriously complicates the administration of either chloroform or ether, and makes any surgical procedure under these anesthetics a matter of great gravity.

Pregnancy is not a serious contra-indication to an anesthetic for appendicectomy, but under these circumstances manipulation or protracted operation encourages abortion.

Diabetes is always a serious contra-indication to a general anesthetic for any purpose, yet I have been obliged to operate several times when there was sugar in the urine, and have done three successful appendicectomies with perityphlitic abscess under this serious complication.

IS THERE A TIME TOO LATE FOR THE EARLY OPERATION AND TOO EARLY FOR THE LATE OPERATION?

The duration of appendicitis is not measured by the duration of the symptoms of appendicitis. The symptoms of appendicitis do not make it possible to diagnose the stage of the disease, and therefore make a reliable prognosis, without or with appendicectomy.

There are many operators and clinicians who set a definite time, usually the end of the first twenty-four hours after the symptoms of acute appendicitis show themselves, which they count the limit of delay for the early operation. Their dictum is that from this time onward, to about the fifth day according to some, or the fifth week according to others, appendicectomy is more dangerous than expectant treatment. Their late operation is recommended after the formation of a perityphlitic abscess, and in point of time several days or several weeks after the onset of symptoms.

It is no part of my plan to refute this teaching. Personally I condemn it as advice difficult to interpret and embarrassing to follow. Worst of all, it builds up a breastwork of sophistry behind which all sorts of negligence, cowardice, and ignorance naturally huddle.

TREATMENT AFTER APPENDICECTOMY

It may not be entirely amiss to more carefully outline the attentions which a patient should receive after appendicectomy. Such details are tiresome to the experienced, but very grateful to the inexperienced.

The patient should have the care of a trained nurse and be put to bed after a general anesthetic with as little shaking up, rolling, or throwing about as possible, and have every trace of the anesthetic washed away from the face. The clothing and towels used during the anesthetic should be left behind in the operating room. During the first few hours the patient should lie supine, with the head low. If the body is covered with perspiration, it should be washed off with alcohol. If the feet and hands are cold, they should be vigorously rubbed and the whole body wrapped up in dry, hot flannels. A bottle filled with warm water, temperature not more than 120, should be placed at the feet, and others of the same kind in each axilla. It is sometimes grateful to the patient to sponge off the face with vinegar and wipe out the mouth with gauze sponges wet in vinegar and water. When the patient vomits, he can be turned upon his side, and if this occurs after he is sufficiently awake, he can rinse out his mouth with a mouthwash. No liquids should be administered during the first few hours after the anesthetic, and the pernicious habit of giving strychnin, digitalis, morphin, or other restoratives and anodynes, should be positively interdicted. The most that can be allowed is an occasional whiff of ammonia or the intercolonic injection of hot, normal salt solution or coffee. The routine administration of gastric sedatives, oxalate of cerium, carbolic acid solutions, minute quantities of cocain, solutions of menthol or thymol, only add to the misery of the patient, and cannot be recommended. After the short anesthesia which appendicectomy usually

requires a few hours of abstinence is enough to dispel all the nausea in patients who were thoroughly prepared before the operation.

When an appendicectomy has been performed as an emergency operation, the early activity of the bowels must be encouraged by enemas. The first enema may be given as soon as the patient is awake. It consists essentially in filling the colon with a hot, emollient enema, which acts as an evacuant of the bowel, and at the same time may be absorbed and relieve thirst. This enema should be repeated at least every six hours, and as often as every three hours if necessary. In some cases where the periappendicular peritoneum has been involved, and there is paralysis or partial paralysis of the bowel, the abdomen becomes distended with gas, and more vigorous enemas are necessary. In these cases after the bowel has been protected by an enema of six or eight ounces of olive oil, an enema of equal parts of magnesium sulphate, glycerine, and water is given with a four ounce rectal syringe. This enema is quickly followed by violent peristaltic action of the colon, and gas and sometimes fecal matter are quickly expelled. It also dehydrates the bowel and thus increases thirst. It has been looked upon as advantageous in peritonitis. This enema should be repeated every four hours, or as often as the distention and gas pains require.

After ideal appendicectomy, the patient frequently wakes up without any nausea, and with very little distress. There is some pain in the laparotomy wound, and some intraabdominal tenderness; but there is no need of morphine and no occasion for restraint. If

gas has been used, the patient can be allowed to sit up at once, and in any case he can be allowed to use a commode or slop-jar every time the bowels move and whenever the patient wishes to urinate. Even cases requiring temporary drainage of the periappendicular abscess may be allowed to sit up by the end of twenty-four hours, and every case of diffuse peritonitis or of presumed general peritonitis should be kept in the semi-recumbent position continuously after the operation. By the end of the first twenty-four hours every subject of ideal appendicectomy ought to sit up and be able to take hot drinks and liquid and semi-solid food, and such patients should be allowed to walk about the room, and even go to an adjoining toilet-room.

Patients who are operated upon under a local anesthetic or under the administration of nitrous-oxide gas may be allowed to drink at regular intervals and when thirsty as soon as they leave the operating room. Under a short chloroform or ether anesthetic, when no nausea is present, patients can usually take liquids by the end of the third or fourth hour; but as a general thing it is necessary to restrain them for six hours. The use of broken ice and hot drinks soon after a protracted anesthetic is extremely undesirable, and only provokes vomiting. Patients who have been operated upon under a local anesthetic or under gas, or with a short chloroform or ether anesthesia, without vomiting, may be given a light diet, composed of nourishing liquids and semi-solids, at the end of the first twenty-four hours. Patients who have not had a preliminary catharsis

should be given small doses of calomel, a tenth of a grain every half-hour until a grain has been taken, and a saline laxative, such, for example, as the effervescing citrate of magnesia, before nourishment is regularly administered. Any patient who has so-called "gas pains," painful peristaltic movement of the bowels, should receive similar treatment.

If vomiting is persistent after the first few hours, and after a thorough emptying of the bowel has been secured, gastric lavage is indicated. It must not, however, be forgotten that long-continued vomiting is generally indicative of peritonitis and obstruction of the bowel, and it must be looked upon as a symptom portending the gravest evil.

When drainage has been used, it should remain undisturbed until firm adhesions have formed, shutting off the general peritoneal cavity from the cavity filled by the drain. This should be expected not earlier than the end of the third or fourth day. When drainage has been introduced on account of oozing, it may be removed by the end of the first twenty-four hours.

The superficial stitches of silkworm gut or silk can be removed at the end of the third or fourth day, and the wound covered with a small dressing held on with zinc-oxide adhesive plaster. With the small incision which appendicectomy requires, and with the permanent stitches in the fascia and undivided muscle, no abdominal support is necessary, and the patient need not be denied any ordinary exertion or exercise. He can leave his bed at the end of the first few hours, be dressed the second day, and go about the hospital or house without any restraint, and leave the hospital or

be discharged cured at the end of a week. If drainage has been used, the patient will require a week or two longer for the closure of the abdominal wound by granulation, but he will be confined to his bed only a few days at the most.

If the nurse in charge of the patient has not received a thorough training, it is often necessary to give her minute directions. She should be required to keep an accurate record of the patient's condition and her treatment. This should include an hourly record of the pulse during the first six hours after the anesthetic, a record of the temperature and respirations every two hours during this time, and for the whole duration of her care of the patient a record of the pulse, temperature, and respirations every four hours, of every emesis, urination, and bowel movement, with the quantity and appearance of each, the kind and amount of food taken, the condition of the skin, the pupils, and psychic manifestations. She should be required to give the patient a full bath not later than three hours after the operation, and massage the whole body with the hand wet in alcohol, or if the patient is dry and cool, covered with talcum powder or lubricated with cocoa butter or olive oil. This first bath should be carefully and slowly given. It is extremely restful to the patient, and is usually followed by a protracted sleep and the disappearance of disagreeable symptoms. After this time the patient should receive at least two baths a day, and these baths should be complete, including the care of the hair, the teeth, and the nails. If the patient is a woman, the utmost pains should be taken to keep the

vulva and labiæ perfectly clean. If the patient is heavy and fat, the folds of the skin, the axilla, and the groin must be not only perfectly bathed, but they must be kept dry with powder. Nothing is more disheartening than to find the patient with grimy knees, dirty finger-nails, stinking axillas, and sweaty groins, and a complacent, prim, and pert person sitting by in the garb of a nurse.

Occasionally the operator is unsuccessful in preserving the aseptic condition of the abdominal wound. The rise of temperature, the increased leucocytosis, the pain about the wound, will call attention to some danger. When the dressings are removed and the wound inspected, a bulging and redness will be noticed about one of the stitches, and tenderness can be elicited on gentle pressure with the sterile index-finger. When this discovery is made, the stitches should be removed and the edges of the skin carefully separated with the sterile dissecting forceps. A little blood and possibly a little serum will escape. If the opening is small, a wick of gauze may be forced to the bottom of the wound, usually against the fascia of the rectus, and a large, hot boric acid dressing applied to promote drainage. This dressing should be renewed every half-hour for five or six hours, after which the drain may be removed and a dry, absorbent dressing applied. The success of this manœuver is indicated by the fall of the temperature, the disappearance of pain, and the recession of the leucocytosis. Generally the bottom of the infection is an infected suture. This must therefore be removed before the suppuration disappears. Sometimes the

symptoms are those of a localized peritonitis, and the infection is found extraperitoneal.

Rarely after an ideal appendicectomy symptoms of peritonitis appear; the temperature rises, the pulse becomes rapid, the patient vomits, tympanites appears, with great tenderness in the region of the operation; the leucocytosis reaches 30,000. Then it is necessary to open the wound to the very bottom, remove the stitches, and introduce drainage. This accident has befallen me once only, the case of N. J., page 68. After the removal of a bloody seropurulent fluid, the temperature fell, and the patient made a prompt, complete, and permanent recovery. Under such conditions the utmost promptness is required and the utmost delicacy in the introduction of the tamponade. The operation can be performed under nitrous-oxide anesthesia.

COMPLICATIONS AND SEQUELÆ OF APPENDICECTOMY

Uncomplicated appendicectomy of the free appendix leaves no trace behind except a small scar and freedom from attacks of abdominal disturbance. There are, however, dangers to be avoided and emergencies to be met increasing in number and in gravity with each succeeding stage of the disease. When the appendix is free the chances of complication are few; when the appendix is adherent, they are more numerous; and when the appendix is surrounded with a more or less extensive infection, they grow more numerous and more difficult to manage.

It is perhaps convenient to consider the complications of appendicectomy as due either to (1) the physical condition of the patient outside the local disease; (2) the influence of the anesthetic; (3) the result of the traumatism; (4) errors in operative technique; (5) the deformities resulting from the operation or the primary disease.

Probably the most serious complication dependent upon the condition of the patient is related to an incompetency of the kidneys. In many patients upon whom appendicectomy is necessary the kidneys have undergone a long process of degeneration, and the added burden of an anesthetic, an operation, the toxemia of the primary disease, or the preoperative use of narcotic doses of morphine, results in oliguria or anuria, which threatens life. The existence of these conditions is sometimes unexpected, the examination of the urine having given no hint of danger, while in other cases the immediate condition was so threatening that a urinalysis was neglected or its warning overlooked. When an acute nephritis has been superimposed on a chronic disease by the operation or by the anesthetic, the resources of the physician will be taxed to the utmost. By the use of vigorous laxatives, by occasional sweats, and when these are inadequate, by the subcutaneous or intravenous injections of large quantities, 2 to 4 pints, of normal salt solution, time may be gained and the kidneys coaxed back to a viable function. When the symptoms of nephritis appear, they must not be attributed too readily to previous disease of the kidneys. Most cases are connected directly or indirectly with sepsis;

either the primary sepsis or one secondary to the operation. The anuria must not be too glibly referred to the anesthetic; it is frequently due to a diffuse peritonitis. If the physician is tempted to exclude sepsis and treat the nephritis as the imminent condition, he must watch very carefully the condition of the heart when giving his sweats and administering his normal salt.

Bronchitis and bronchopneumonia are complications frequently due to the existence of a chronic disease in the bronchial tubes which breaks forth as the result of the combined influence of the infection and its action upon the heart, the anesthetic acting locally or as a toxemia, and the traumatism which frequently is necessary when resuscitation is required. These conditions are most apt to follow in the aged, in asthmatic patients, and those with chronic bronchitis with emphysema, and in patients who have serious valvular lesions of the heart. It also appears in the obese and in cases where inspiration of the secretions of the nose and pharynx are allowed to take place. Although this is a rather grave complication in some cases, it is rarely a fatal one except in the aged. The treatment is wholly symptomatic and expectant, the cough must be allayed by moderate doses of narcotic expectorants, and the heart sustained by judicious stimulation. The chest and neck, so sensitive in these patients, should be well protected with flannel and kept dry by repeated sponging with alcohol. Every form of irritation should be eliminated, especially a dusty atmosphere.

Pregnancy is a common complication of appendi-

citis. It sometimes complicates the disease and sometimes the operation, and appendicitis is a not uncommon cause of peritonitis in the puerperal state, and it must be differentiated from puerperal septicemia. When appendicectomy is necessary in the course of pregnancy, there are added reasons for an early operation. When the disease is allowed to go on to the formation of periappendicular abscess, besides the ordinary risks of life, the patient is apt to abort, and in any case the nutrition and development of the fetus is retarded. Pregnancy is not a contra-indication to appendicectomy, but rather an added indication.

Diabetes and acetonemia and other obscure degenerative diseases, such as acute yellow atrophy of the liver, appear after appendicectomy, and may possibly depend upon some latent, undiscovered, and possibly undiscoverable, condition in the patient. The so-called acute yellow atrophy of the liver has been referred to in a foregoing section (page 213). Diabetes is occasionally noticed after anesthetics, and has been quite extensively feared as a complication. It is sometimes attributed to the toxemia of the chloroform or ether, but more often is looked upon as an inherent vice in the patient.

Acetonemia has been occasionally observed after appendicectomy, and this grave accident is becoming more and more feared, especially after the administration of chloroform in patients where a trace of septic infection is left behind in the abscess wall or in some remote location. It seems to occur more often in young adults and children, or with those with the

history of diabetes, than in others. The following rather obscure case (Annals of Surgery, Vol. 36, p. 481, October, 1902,) is abstracted from Brewer's report:

S. S., aged twelve years, a school-boy, was admitted to the Roosevelt Hospital on April 29, 1901. There was nothing in the family history nor in the previous history of the patient which could have any bearing upon the pathological condition which is to be described. Previous to this illness he presented every evidence of the most robust health.

Two days before his admission, after a long and rather fatiguing military drill at his school, he was suddenly seized with an acute abdominal pain, which was more or less general at first, and was accompanied by nausea and vomiting. Later the pain became more severe, and was referred to the right inguinal region. There was a slight elevation of temperature and an increase in the pulse-rate. He was seen by Dr. Edson, his family physician, early in the evening, and on examination he found tenderness and muscular rigidity in the right lower quadrant of the abdomen. Appropriate treatment was prescribed, including an ice-bag to the inguinal region. The following day there was a very considerable improvement in all the symptoms; the temperature had fallen to 99.8, pulse to 90, and there was no pain.

He passed a comfortable day, but during the following night the pain returned, and on the morning of his admission to the hospital, as the temperature was 101, pulse 110, leucocytes 17,000, an immediate operation was advised. After the usual preparation, under chloroform anesthesia, an incision was made over the region of the appendix and the abdominal cavity opened by the intermuscular method. Examination revealed the presence of a tumor composed of intestine, omentum, and the inflamed appendix glued together with plastic exudate, and situated in the iliac fossa near the anterior superior spinous process. After walling off the intestines with gauze pads, the adhesions were separated, and a perforated gangrenous appendix found in a small abscess cavity which contained about two drachms

of foul-smelling pus. The appendix was removed, the cavity disinfected, two cigarette drains introduced, and the wound partly closed. Duration of anesthesia about twenty-five minutes.

After his return to his room his temperature was found to be 103, pulse 120, and of good quality. As his general condition at that time seemed satisfactory, no stimulation was ordered. Considerable pain followed his recovery from the anesthetic, which was relieved by one-eighth grain of morphine. There was no vomiting, and he was able to take and retain water by the mouth four hours after the operation. During the night he became restless and complained of more pain, but was again quieted by a small dose of codeine. The following morning he seemed bright, the temperature had fallen to 101, and the pulse to 88; he took and retained fluid food; later in the day there was a still further drop in the temperature. He complained of some distention; an enema was given, which resulted in a fairly large yellow movement.

The second night after operation was a comfortable one; his distention was relieved, gas passed freely by the rectum, and he slept about six hours. The following morning his temperature had fallen to normal, his pulse to 76; he seemed cheerful and happy, and expressed himself as free from pain and hungry. The wound was dressed, and was found to be in a satisfactory condition. The abdomen was flat; there was no rigidity, and only slight tenderness in the wound area. Calomel and salts were administered; the bowels moved again, and much gas was expelled.

During the entire day his temperature remained normal, and his pulse never rose above 80. He slept most of the afternoon and made no complaint. The urine, which before operation had been normal, to-day showed a slight trace of albumin and a few finely granular and hyaline casts; no sugar, pus, or blood.

The following night he slept quietly until shortly after midnight, when he suddenly awakened, and without any apparent cause, uttered a piercing shriek, which was so agonizing and expressive of terror that it not only greatly alarmed his nurse, but also his mother, who was sleeping in an adjoining room. He continued to scream for several seconds, looked wildly about,

and apparently failed to recognize those around him. A few moments later he again fell asleep and rested quietly until the morning. The symptoms were at first attributed to a bad dream or nightmare. The following morning he was distinctly somnolent, and when aroused would cry out and appear for a moment very much frightened, but would be easily soothed by his mother, after which he would again fall into a quiet sleep. His temperature was 98.5, pulse 74; the abdomen was soft; there was no distention; the secretion of urine was free and of the same character as on the preceding day. He was seen by the writer at about eleven o'clock in the morning. He was then sleeping soundly, and appeared in every way normal. On waking him he again uttered an agonizing cry and looked the picture of abject terror. His eyes wandered from one person to another without the slightest sign of recognition. He continued to scream with such vehemence that his cries were heard all over the building. All efforts to soothe him seemed unavailing; his terror was painful to witness, and the whole picture suggested unspeakable fright and the most acute mental suffering. These paroxysms would last from a few seconds to two or three minutes, and would be succeeded by a comparatively long interval of rest, during which he would apparently be sleeping quietly.

The pupils were symmetrical and reacted to light and accommodation. There was no evidence of cranial nerve palsy or irritation. There was no impairment of sensation or motion in any part of the body; the reflexes were apparently unaffected. His temperature and pulse remained normal, and there was nothing to indicate any gastro-intestinal irritation, pulmonary or cardiac disturbance. I immediately called my colleague, Dr. Blake, in consultation, and after a thorough examination, he agreed with me that the wound conditions were satisfactory, and that there was no evidence of sepsis. He was unable, however. to offer any explanation of the mental symptoms, and we both agreed that the opinion of an expert neurologist should be obtained as soon as possible. As the parents urged us to call upon any one who could be of service to us, a consultation was quickly called, at which Dr. Edson, the family physician, Dr. Blake, Dr. Pierce Bailey, and Dr. George L. Peabody were

present. After carefully reviewing the history of the case from the beginning, and repeating the previous examinations, during which the child passed through several of the screaming paroxysms, the consensus of opinion as expressed was that the patient presented evidences of extreme cerebral irritation, the cause or causes of which could not at that time be discovered, as none of the gentlemen present had ever seen or heard of a similar case.

During or shortly after the consultation the writer noticed a peculiar sweetish, ethereal odor of the breath, which was verified by each one present. The nurse stated, in answer to inquiries, that she had noticed that peculiar odor ever since she came on duty at seven o'clock in the morning. The opinion was expressed that the odor was in all probability that of acetone, and indicated a condition of acetonemia which might be a causative factor in the production of the symptoms. As none of those present at the consultation had ever observed symptoms due to acetonemia in conditions other than diabetes, and as the symptoms of acetonemia in diabetes were usually those of a rapidly deepening coma, rather than delirium and cerebral irritability, no definite conclusion could be arrived at until more complete examination of the urine or blood could be made, and further observations of the symptoms and progress of the case. Meanwhile the symptoms were increasing in severity, the paroxysms occurring more frequently, the character of the delirium becoming more distressing, and the intervening sleep deeper and more resembling coma. At 6 P. M. the temperature was still normal; the pulse during sleep 80, but weaker; physical signs unchanged. An hour later the patient was seen in consultation by Dr. Evan Evans, who expressed very positively the belief that the symptoms were due to an acute autointoxication, which is associated with the presence of acetone and diacetic acid in the blood. He gave an extremely grave prognosis, predicting death within twenty-four hours unless the symptoms were speedily relieved by free catharsis, diuresis, and the intravenous injection of a solution of chemically pure bicarbonate of sodium. Dr. Evans examined the urine and blood and found large quantities of both acetone and diacetic acid in each.

At 8 P. M. 400 ccm. were withdrawn for laboratory examination, and a thousand ccm. of normal salt solution were transfused, to the last of which about 15 gm.. of chemically pure bicarbonate of soda were added. The stomach was washed out and a large dose of epsom salts and calomel introduced through the tube. After an hour's rest he was given a prolonged hot saline irrigation of the rectum by means of a Kemp's tube. An hour later another dose of epsom salts was administered with a stomach tube, followed by a high enema of turpentine, glycerine, and soap-suds. As there had been no spontaneous urination for several hours, he was catheterized, and a moderate quantity of urine, having a very strong odor of acetone, was withdrawn.

During this time the character of the symptoms underwent a change. The paryoxysms of screaming were of shorter duration, and occurred less frequently. The intervening sleep was more profound, the pupils were more dilated; he was less easily wakened by treatment. There was no change in the temperature, although the pulse increased somewhat in frequency, and was evidently growing weaker. Several fruitless efforts were made to secure a movement of the bowels, and toward morning his temperature rose to 103, the paroxysms of delirium ceased, and he fell into a condition of progressively deepening coma. Early in the morning, as there had been no movement of the bowels, the cecum was opened in the wound, and the bowel freely irrigated, but without producing any change in the symptoms. He grew steadily worse, and died at 11 in the morning. No autopsy was made.*

Parotitis occasionally complicates appendicitis without appendicectomy, but it seems to be more common after the operation. Its etiology is unknown. It is believed to be due in many cases to

* Brewer gives the following test for acetone: Place 20 ccm. of urine in a small glass retort, heat over an alcohol flame, and condense the vapor in a cold test tube; then add a small amount of potassium hydrate to render the reaction alkaline; after which add four or five drops of Gram's solution of iodopotassic iodide, and heat gently. If acetone is present a strong, iodoform odor will be produced, and yellow crystals will form in the tube.

the infection of Stenson's duct during the anesthetic. It is possibly a sort of pyemic infection. In itself it is relatively devoid of danger, but it adds greatly to the misery, the suffering, and the sepsis, of the patient. I have never observed it except in one case of appendicectomy with the drainage of a large periappendicular abscess. In that case the parotid suppurated and closed after a short period of drainage.

Silk ligatures, sponges, concretions which have escaped from the appendix, and instruments have all given rise to complications which follow the complete closure of the abdominal wound and a more or less protracted period of health. Foreign bodies have thus been found the center of abscesses months and years after appendicectomy. Such accidents are avoided by proper operating-room technique and by the use of the small incision and the temporary absorbable ligature.

Periappendicular abscesses frequently dissect into distant parts of the body, and produce cicitricial contractions and deformities which seem most remote. In one instance which came under my own observation, a patient had suffered a sharp attack of appendicitis, with protracted abscess formation and dissection into the right thigh and groin. After a time the abscess opened; a large quantity of pus was discharged, and recovery followed; but the thigh was contracted upon the abdomen, and the resulting scar prevented extension. This happened when the boy was only thirteen or fourteen, and although he was extremely active and athletic, he was never able to bring his hip joint into use. After making careful measurement and skia-

graphic demonstrations of the absolute perfection of the bones of the pelvis and of the femur, I anesthetized him on three occasions and made violent extension under systematic tenotomy and myotomy, and succeeded in bringing the thigh into relatively complete extension and lengthened the leg more than four inches.

Adhesions between the intestines and the colon, between the small intestine and the omentum, between the colon and the stomach, give rise to most unexplainable attacks of abdominal pain and to paroxysms which resemble biliary colic, the colic of stones in the ureter and gastric crises. When the abdomen is opened under such circumstances, nothing is discovered except trifling adhesions between apparently perfect viscera, and the removal of the adhesions is followed by relief from pain.

Remnants of infection in mesenteric lymph glands, in the sheaths of muscles, in the perivesicle tissues, in the perirectal tissues, and elsewhere, remain dormant for months or years, and then, without any reasonable provocation, break forth into abscess formation, confounding the diagnostician and embarrassing the surgeon who was so unfortunate as to perform a tardy operation. Three years after an appendicectomy Cullen opened and drained a retrocecal abscess in a frail boy of fourteen.

Tumor of the cecal wall following the removal of the appendix has been reported. The patient had been operated upon in 1902, and typical appendicectomy between attacks had been performed. Six months later he was admitted to the hospital with

symptoms of appendicitis. It was thought probable that the appendix had not been removed. There was a small, hard, sensitive mass in the region of the cecum under the scar of the previous operation. When the abdomen was opened, no appendix was found, but at its site there was a small, hard tumor three-quarters of an inch in diameter, projecting externally and also into the lumen of the cecum. It was excised and the abdomen closed. The mass was examined microscopically and pronounced to be a chronic inflammation of the wall of the stump of the appendix.

Subphrenic abscess does not differ materially from abscess in other parts of the abdomen except in symptoms and difficulty of diagnosis. It is a relatively common complication of periappendicular disease. Out of a material collected by Christian and Leher of 4,028 autopsies, among which 86 deaths were due to appendicitis, 7 showed involvement of the subphrenic region, though in a strict sense every case was not a subphrenic abscess. Five of these cases were males and two were females. Their ages varied between eleven and fifty. In five of the seven cases the appendix had been removed. In one the cecum and appendix were bound down by fibrous adhesions, and behind the cecum there was an abscess. In one the appendix was bound down by adhesions, its distal half was gangrenous and riddled with perforations.

Subphrenic abscess occurs in other conditions, and it may originate from the appendix in at least three ways. First, and generally, by extension up the retrocecal peritoneum; second, by way of the portal

circulation; and third, through involvement of the lymph apparatus. If the study of the extension is of any clinical significance at all, it speaks for early, complete, and ideal appendicectomy.

Either as the result of the anesthetic, or as the result of regurgitation and vomiting from the nausea it produces, or from the vomiting which results from the primary disease, cholangitis, probably with duodenitis, is occasionally observed during appendicitis and after appendicectomy. It must always be looked upon as a serious complication and liable to portend the most grave conditions. It is observed in nearly every case of general peritonitis and in many cases of acute nephritis. No symptom is more alarming to the operator than the appearance of a little discoloration of the conjunctivæ and a subicteric condition of the skin coming on about the second day after appendicectomy. This is especially the case when a diffuse peritonitis has been drained. Very little can be done for this condition when it is a symptom of peritonitis, but if it indicates simply a local infection of the biliary tract it may be treated as a gastroenteritis. The administration of small quantities of phosphate of soda and a restricted diet is usually sufficient and shows its effect in forty-eight hours.

Acute dilatation of the stomach is a rare complication of appendicectomy, and is more apt to appear in the young and the old and debilitated than in such adults as usually suffer of appendicitis. It appears either soon after the anesthetic or at any time during the first two weeks after the operation. It is characterized by pain in the region of the stomach, vomiting

of bile-stained fluid, and by enormous extension of the area of stomach tympany. The course of the disease is short; it either terminates favorably after vomiting or after gastric lavage, or the dilatation increases and the patient dies within two or three days.

CONCLUSION

Every case of appendicitis is a case for appendicectomy. The acute cases should be operated upon at once, the chronic cases as soon as the best surroundings can be secured. Ideal appendicectomy ought not to require an incision longer than an inch in the thin and an inch and a half in the fat patient; it ought not to require more than fifteen minutes of general anesthesia nor more than four or five days in the hospital and away from work or business; it ought not to cost more than fifteen to fifty dollars for hospital expenses, or an equal sum for trained nurses when the operation is done at home. The dangers of ideal appendicectomy are confined almost entirely to the anesthesia, and they are immeasurably small or dependent upon irremediable diseases outside the appendix.

The dangers, the distress, and the expense of a pampered case of appendicitis cannot be foretold or estimated, and the far-reaching consequences of chronic infection are calamitous and insidious.

BIBLIOGRAPHY OF APPENDICITIS

The bibliography of appendicitis is to be studied in the Index Catalogue of the Library of the Surgeon General's Office, 2d Series, Vol. 1, pages 594 to 601, inclusive; in the current numbers of the Index Medicus, and especially in an excellent monograph by George M. Edebohls, entitled "A Review of the History and Literature of Appendicitis," in the Medical Record for November 25, 1899. He gives 376 important articles.

The current literature of appendicitis can be studied in such abstracts as Gould's Year Book, Virchow and Hirsch's Jahresbericht, Head's Practical Medicine Series, and Progressive Medicine.

The literature of appendicitis is voluminous, and in a very large degree worthless, because this condition has called out so many irrational ideas of hypothetical pathology and empirical treatment.

CHAPTER VIII

PERITONITIS

Forms of peritonitis; physiologic resistance of the peritoneum to infection; peritonitis a terminal disease, preventable but not curable; the peritoneum a distended lymph space; the histology of the peritoneum; the anatomy of the peritoneal pouches and pockets; the physiologic problems of the peritoneum; the pain of peritonitis; the etiology of peritonitis, idiopathic, traumatic, chemic, and infectious; the sources of infectious peritonitis; the clinical picture of peritonitis; the course of peritonitis; diagnosis of peritonitis; treatment of peritonitis.

Excluding the rare possibilities of a mechanic or a toxic, chemic, irritation, peritonitis, in the clinical sense at least, is always due to some form of infection. In the ordinary suppurative peritonitis this infection is the staphylococcus, the colon bacillus, or the gonococcus, or other kindred microörganism. In tuberculous peritonitis the tubercle bacillus is the prime causative factor. The pneumococcus is responsible for pneumococcic peritonitis, and in rarer cases other microörganisms are found. The course of the disease, and the possibilities of recovery or spontaneous disappearance of the inflammation, depend, in a measure at least, upon the specific character or the acquired virulency of the infection.

Among the most prominent factors which come

into the problem of a peritonitis are the physiologic relations of the peritoneum, the anatomy of this enormously distended and complicated lymph space, and the ceaseless activities of its contained viscera.

The three great serous cavities of the body are quite differently related to the sources of possible infection and they seem to have acquired different degrees of immunity or resistance to infection. The cerebrospinal cavity, or the cerebrospinal lake, is far removed from any infection except through pathologic condition of the middle ear, the antrum, and the mastoid cells. It presents the clinical picture of the least possible amount of resistance to infection. When it has once become infected in one part, the whole cerebrospinal cavity is quickly subject to the infection, which is carried by the constant stream of cerebrospinal fluid which fills it. Only when the infection is of a low grade, or when it is self limited in its development, is there any possibility of reaction and recovery.

The pleural and pericardial cavities stand somewhat closer to the possibilities of infection, and they seem to have acquired in the process of evolution a greater resistance to infection, and possibly some immunity. It is certain that we see cases of pneumococcic pleuritis that recover spontaneously through the arrest of the progress of the infection and the absorption of the exudate. When, however, the microörganisms which always swarm in the upper air passages are carried from the smaller bronchial tubes, which they invade in the course of bronchitis or pneumonia, through the lymph channels, and are

poured out into the pleural cavity, a progressive and destructive infection follows which can be brought to an end only by adequate drainage.

The peritoneal cavity is the largest and the most closely related to possible sources of infection. It communicates directly with the external world in the female through the vagina, the uterus, and the Fallopian tubes. In both males and females it is in the closest proximity to a constant and most extensive mass of infectious material, namely, the contents of the stomach, the intestinal tract and its appendages. It is separated from this seething mass of infection by the thin intestinal wall, which is itself liable to defects as the result of external or internal traumatism and various forms of ulceration. The appendages of the intestinal tract, especially the appendix vermiformis, the gall-bladder, and Meckel's diverticulum, are traps laid for the purpose of catching and disseminating infection. Thus, through the evolution of the peritoneal cavity great immunity to infection seems to have been acquired by the peritoneum, and various modes of arresting or localizing the infection have been taken advantage of. Were it otherwise, the existence of the present mammalian peritoneum could not be imagined.

Clinically peritonitis is a hopeless terminal disease, except when by some rare chance it is limited to a small portion of the peritoneum. The study of peritonitis is of interest to the physician far less on account of its treatment than on account of its possible prevention. The serious result of peritonitis makes the study of any feature of the peritoneum of

the utmost interest. Nothing can be neglected, either in the physiology or anatomy of this largest serous cavity in the body.

The peritoneum is essentially a lymph space and a lymph channel. From every organ of the abdomen, the liver, the pancreas, the spleen, the intestinal tract, and the genitourinary organs, streams of lymph pass in and out of their peritoneal coverings when they are in a state of hyperemia or engorgement. There is always a small quantity of serum bathing the surfaces of the abdominal viscera. It is likely that certain portions of the peritoneal surface are almost exclusively absorbent, presumably the posterior peritoneum and the coverings of the mesentery and omentum. The quantity which passes through the peritoneal cavity in a given time has been variously estimated, but in any case it is looked upon as a rich and rapid lymph circulation.

The minute anatomy of the peritoneal surfaces is relatively simple. The cells which cover the surfaces are attached edge to edge in such a way as to leave numerous stomata or mouths communicating directly with the subserous lymph channels. These stomata are of very considerable size and have a more or less definite configuration. Below the serous layer there is a rich network of capillaries, held in a rather firm connective-tissue membrane. In the course of inflammation these blood-vessels are enormously distended, and the delicate serous and subserous tissues become hypertrophied to such a degree that they feel hard and thick like the palm of the hand. In various places beneath the serosa, especially in the mesentery

and the inguinal abdominal wall, there are great chains of lymph glands, which vary from the smallest perceptible nodules to glands the size of walnuts. Each of the abdominal organs has a special system of lymphatics gathering up the lymph from the serous surface and collecting it at the hilum or at the mesentery of the organ. The course or direction of the lymph streams is of the greatest clinical interest, especially when any surgical procedure is undertaken upon a large viscus like the stomach. The peritoneum is supplied with nerves entirely from the sympathetic plexus. These nerves carry little or no painful sensations until they have undergone changes in the course of inflammation.

The extent of the peritoneal surfaces is something enormous. Every abdominal viscus and organ, including more than twenty feet of intestine and its mesentery, the omentum and the abdominal walls, is covered by this delicate serous membrane. This surface has been estimated at more than 25 square feet. From its very extent the gravity of peritonitis can be predicted. It is fortunate for the clinician that the peritoneum is divided by the various organs into two more or less distinct cavities, with further subdivisions into pockets or fossæ, any one of which may be the site of disease, while the others remain uninfected. From a clinical standpoint there are two peritoneal cavities, the upper and the lower, the cephalic and the caudal, separated from each other by the stomach, the transverse colon, and the omentum. A certain group of primary diseases gives rise to a secondary peritonitis in the cephalic peritoneal

cavity, while another and wholly distinct group of diseases gives rise to peritonitis in the caudal peritoneal cavity. This division is of great diagnostic significance, and it is the duty of the diagnostician to early determine the probability of infection in either of these cavities. Infectious cholecystitis or cholangitis, pancreatitis, gastroduodenitis, ulcer of the stomach or duodenum, or infarcts of the liver and spleen, give rise to a secondary peritonitis in the cephalic cavity, while an appendicitis, a perforating typhoid ulcer, a pyosalpinx, a rupture of the urinary bladder, or intussusception, gives rise to a peritonitis in the caudal or lower peritoneal cavity.

The embryologic development of the peritoneum and the various excursions that take place and attachments which are formed in the production of the adult peritoneal cavity are considered in a subsequent chapter. The anatomy of the adult peritoneal cavity must, however, be considered here. If the abdominal viscera are removed, the posterior abdominal wall in the male presents the appearance semi-diagrammatically represented in Plate V., which has been modified from Plate 355 of Deaver's Surgical Anatomy. Beginning about the middle of the plate the transversely cut caudal end of the first portion of the duodenum is seen, with the attached common duct to the right of the hepatic artery, and a short distance below this is seen the raw surface extending transversely across the abdomen, from which the stomach and transverse colon have been removed. With the attached spleen this raw surface, which represents the severed mesocolon, divides the cephalic from the caudal portion

of the posterior parietal peritoneum. Below the mesocolon there are four quite distinct longitudinal divisions of the posterior peritoneal wall, making four quite distinct peritoneal valleys. These longitudinal divisions are produced by the ascending mesocolon on the right, the mesentery of the small intestine in the middle, and the descending mesocolon on the left. Each one of these valleys or fossæ may become the site of peritonitis, and the other fossæ remain uninfected.

1. If the liver is raised up and the left index finger is passed with its palmar surface near the right border of the gall-bladder and then gradually insinuated downward, always to the right of the common duct, it will pass upward into a fold of peritoneum just large enough to contain it, and into a considerable peritoneal pouch known as the lesser or little peritoneal cavity. This opening in which the finger finds itself is the foramen of Winslow, and it is a point of great surgical and anatomic interest. This foramen is shown with its anatomic relations in Plate VI.

2. If the colon and omentum are raised upward and the ileum drawn toward the right so that the left index finger holds the last cephalic portion of the jejunum on its palmar surface, the opposing right index finger can be brought on the left side of the jejunum, against the pulsating superior mesenteric artery and the transverse portion of the duodenum, into the duodenojejunal fossa. The origin of this fossa is explained in the chapter on the embryology of the peritoneal cavity. This foramen is sometimes known as Treitz's foramen. It is of great surgical

PLATE V

This plate is intended to show the division of the dorsal wall of the peritoneal cavity into various fossæ and pouches. Near the center of the plate, and just below the section of the duodenum, is seen a transverse raw surface, separating the upper, cephalic, peritoneum from the lower, caudal, peritoneum. This raw surface was produced by removing the transverse colon, under the mesentery of which the jejunum dips, showing its section in the shadow to the right of the middle line of the picture, and directly over the ileocæcal fossa. From the section of the jejunum there runs downward through the center of the picture turning at last toward the right iliac fossa, a raw surface, in close contact with the superior mesenteric artery, and containing the cut ends of the mesenteric arterioles. This raw surface was produced by the removal of the twenty feet of ileum. It separates the right ileocolic fossa from the left. At the termination of this raw surface in the right iliac region there is a broad, raw surface extending upward, from which the cecum and ascending colon were removed. Lateralward of this denuded surface is a fossa upon which the infection from the appendix crept and produces the subhepatic abscess, and down which the infection from a perforating ulcer of the duodenum crept to the caudal peritoneal cavity. This fossa is bounded lateralward by the parietal peritoneum, and it opens caudally into the pelvic peritoneal cavity. In the upper right hand corner of the plate is seen the cut end of the esophagus, and to the right of this the dorsal wall of the lesser peritoneal cavity, which is bounded ventrally by the dorsal wall of the stomach, the dorsal attachment of which has been cut away, leaving a raw surface extending from the section of the esophagus caudad and toward the right of the picture through a section of the spleen to the end of the section of the mesentery of the transverse colon where it joins the descending colon. It contains the cut ends of the gastric artery above and splenic artery below. In the center of the plate, and near the bottom, is seen the cut end of the rectum, and extending upward, cephalad, and toward the right of the picture in an S-shaped course, is seen the raw surface from which the sigmoid and ascending colon have been cut away, thus dividing the peritoneal cavity again into a fourth longitudinal fossa.

Beginning at the cut end of the esophagus again, and extending toward the left of the picture, is a broad, irregular, denuded surface, from which the attachments of the liver have been removed, exposing the diaphragm and two cut ends of the inferior vena cava. From this raw surface, and extending upward in the middle line, dividing the peritoneal surfaces of the diaphragm into two portions, is the raw surface produced by the section of the falciform ligament of the liver.

Thus, beginning at the top of the plate, we have five distinct pouches or fossæ of peritoneum, any one of which may harbor infection, and from any one of which infection may go out into all of the other fossæ: the lesser peritoneal cavity, or the retrogastric peritoneal pouch, usually infected from the dorsal wall of the stomach, the cephalic peritoneal cavity, usually infected from the gall bladder, the common duct, the pyloric end of the stomach, or the first portion of the duodenum, the right ileocolic fossa, usually infected from the appendix; the left ileocolic fossa, rarely the site of primary infection, and the pelvic fossa, usually infected from the genitourinary tract. Lateralward of these five fossæ are the right and left retrocolic fossæ, the former of which is usually infected from the appendix, but sometimes from the biliary tract or the kastroduodenal region.

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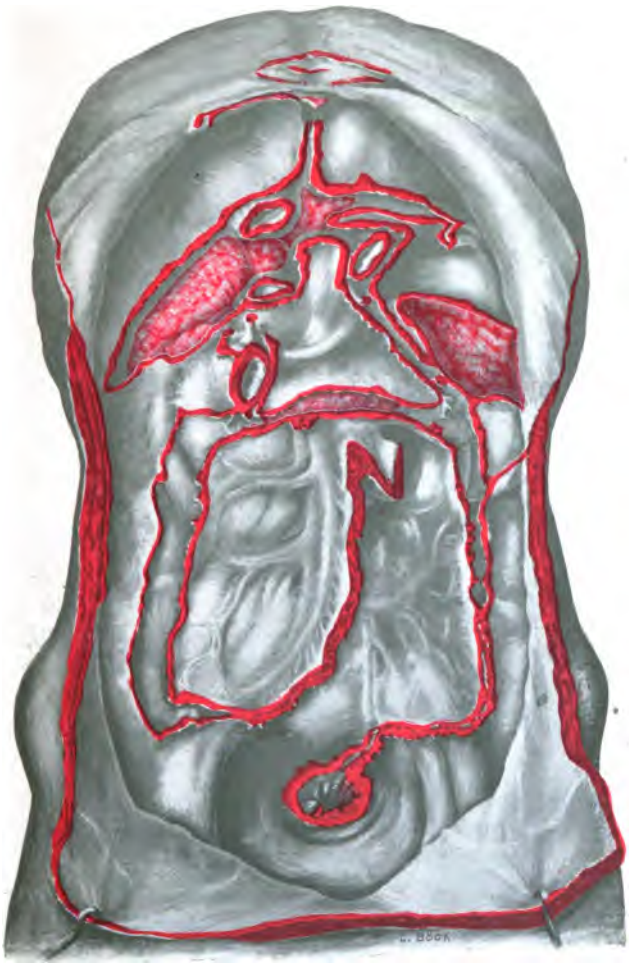

interest on account of the occasional occurrence of hernia into this fossa or recess. In about two-thirds of all individuals this foramen admits the index finger and the fossa holds the thumb as far as the first joint only.

3. Behind the mesentery at the angle of junction of the ileum and cecum there is a peritoneal pouch known as the ileocecal fossa, which sometimes reaches as far upwards under the cecum as the right kidney. It is bounded upon the right by the mesentery of the appendix and cecum, and upon the left by the mesentery of the ileum, containing the ileocolic artery. It is covered above, in the ordinary position of the intestines, by the ileum, and in some subjects by the ileocecal fold. In this embryologic peritoneal pouch the vermiform appendix is often left behind and firmly attached (Fig. 35, p. 192). This pouch is often the site of periappendicular abscesses which are separated from the general peritoneal cavity by adhesive peritonitis.

4. The ileocolic fossa is a superficial fold, which is found in some cases, especially when the ileocecal fossa is absent. It is fitted into the angle of the ileum and colon, and is usually too shallow to be of much clinical interest. It is bounded on the right by the ascending mesocolon and caudally by the mesentery of the ileum, and is separated from the greater ileocolic valley on the right by the ileocecal fold and the prominence given the peritoneum by the ileocolic artery.

5. The intersigmoid fossa is a fold of peritoneum which has attained great clinical significance from the

the colon bacilli from the strangulated intestine or vermiform appendix. In any case the presence of a fluid in the peritoneal cavity is a source of danger to the patient, for it is likely to become the culture medium of any microörganisms which might gain access to the peritoneal cavity.

The nerve supply of the peritoneum is derived from the sympathetic plexus. It is but poorly supplied with sensory fibers. The peritoneum of the intestine or other abdominal viscera can be handled gently without the production of anything but an indistinct malaise. The appendix vermiformis, the gall-bladder, or a Meckel's diverticulum may be removed under local anesthesia for the abdominal incision without producing anything like the amount of pain which a similar operation would produce upon the lip, the tongue, the tonsil, the prepuce, or even the cervix of the uterus. When, however, the peritoneum is roughly handled, the shock which results produces a remarkable fall in the intraarterial tension. Upon animals Crile has shown that the diaphragmatic peritoneum and the peritoneum of the cephalic peritoneal cavity is much more intimately connected with the production of shock than that of the caudal peritoneal cavity. The shock is diminished when the peritoneum has been very lightly cocainized. It is a frequent clinical observation that rupture of a viscus produces sudden and terrible shock.

When the peritoneal surfaces have become irritated or inflamed, they take on a very decided sensory function. The pain of a peritonitis is one of the most agonizing which can be imagined or suffered. Fre-

quently the progress of a disease of the gall-bladder or appendix gives rise to temperature and symptoms of intoxication, but after the peritoneum is involved the first painful symptom appears. In some cases the gall-bladder, for instance, is filled with pus and greatly distended, rendering the peritoneal covering anemic and therefore anesthetic, so that rupture of the distended viscus occurs without pain, and the first symptom is shock, quickly followed by the pain of a general peritonitis.

If we look upon peritonitis from the standpoint of its etiology, we are concerned very promptly with the possibility of a primary or idiopathic peritonitis. From a theoretic standpoint the peritoneum, the pleural cavities, the pericardium, the serous cavity of any joint may be the site of an inflammatory process produced by a microorganism or infection which has left no signs of its progress from its atrium in the digestive, respiratory, or cutaneous surfaces to the serous surface itself, but as a matter of fact, this theoretic possibility is not sustained by clinical observation. A pleuritis is the result of a pneumonia, an infarct of the lung, an osteomyelitis of a rib or vertebra, a ruptured mediastinal lymphadenitis, a perforating ulcer of a stomach attached to the diaphragm, or other adjoining infection. The same explanations follow the study of pericarditis and joint infection. Grawitz found 867 cases of peritonitis in the Charity Hospital between 1876 and 1885 out of 8,421 post-mortem examinations. In 13 of these he was unable to demonstrate the source of the infection in an adjoining organ, and was obliged to put them down as

cases of primary peritonitis. Later observers have made a more careful study of the sources of peritonitis, and as a result Benda and Habershon were able to demonstrate the source of the disease in almost every case which came to autopsy. Primary or idiopathic peritonitis is a theoretic ghost, which has always been feared by diagnosticians, but never observed either by the pathologist or by the surgeon.

A peritonitis may be the result of traumatic irritation. In this case it is reparative and self-limited, and leaves no trace behind it except the adhesions which may result from the attachment of the inflamed peritoneum of one viscus to that of the abdominal wall or of another viscus. Such cases of traumatic peritonitis follow injuries of the abdomen, rupture of the capsule of the liver, of the spleen, of a fibroid of the uterus, or the peritoneal covering of the uterus itself, of a distended intestine, or other abdominal organ. These injuries to the peritoneum result in local, reparative, adhesive peritonitis. This peritonitis presents all the symptoms of an infectious peritonitis except those that relate to or depend upon toxemia. The shock and pain are present, but the rise in temperature is trifling and transitory, and the leucocytosis is insignificant and rapidly receding.

Peritonitis of a chemic origin arises from the irritation of a transudate: the escape of urine, or the rupture of an ovarian tumor or pancreatic cyst or gall-bladder into the general peritoneal cavity. These rare clinical findings are quickly overshadowed by the appearance of infection in the transudate and exudate. The symptoms of the chemic peritonitis are

similar to those of a traumatic peritonitis except in that the whole peritoneum is apt to be involved. The shock and pain are therefore more extensive and serious, and a certain sort of toxemia is added to the picture. This toxemia may differ in no respect from that of an infectious peritonitis except in that it is non-progressive and self-limited. The patient may, however, die of the rapid toxemia, or if she survive, the toxines of the ruptured ovarian tumor, for example, may be all eliminated and health restored. There will then be left behind only those results of the peritonitis which would follow a traumatic peritonitis involving the same viscera.

When an uninfected gall-bladder or common duct is opened into the peritoneal cavity it gives rise to a chemic peritonitis which continues as long as the irritating bile leaks through the rupture. As soon, however, as the rupture closes the escaped bile is absorbed and the exudate which covers the irritated peritoneum undergoes regenerative changes and disappears, leaving the dangerous adhesions to confound the diagnostician.

The prime and only important etiologic factor in peritonitis is the infectious microörganism. The three important sorts of infection are:

(1) Those microörganisms that infect the peritoneum whose ordinary habitat is the intestinal tract, namely the staphylococcus, the colon bacillus, and the streptococcus. These microörganisms and those which accidentally accompany them as messmates or as pathologic accidents of the intestinal tract, such as the influenza bacillus, the bacillus of dysentery, or

possibly the typhoid bacillus, produce the greater number of cases which we are called upon clinically to observe or treat.

(2) Those that enter the peritoneum from a septicemic condition, such as the tubercle bacillus in acute miliary tuberculosis, the pneumococcus, the gonococcus in males, and possibly occasionally in females.

(3) Those microörganisms that come from the external or adjoining parts, not the intestinal tract, as for example the gonococcus in pyosalpinx, the tubercle bacillus in tuberculosis of the mesenteric lymph glands, or in Pott's disease of the spine, and the staphylococcus and streptococcus in cases of rupture of the urinary bladder, perinephritic abscess and perforating wounds of the abdominal wall.

The reaction of the peritoneum to infection depends almost entirely upon the character and quantity of the infection. The first effect of a peritonitis due, for instance, to the colon bacillus is the effusion of a fibrinous or serous exudate, which results in causing an agglutination between opposing peritoneal surfaces. This agglutination is more rapid when the effusion is slight and coagulable, and slow or absent when the effusion is rapid and serous. The peritoneal surfaces are at once swollen and turgid; the capillaries are greatly enlarged, and the subserous connective tissue is increased to an enormous extent. The underlying blood-vessels frequently undergo such changes in their walls that a thrombosis, at first mural and then obliterating, takes place. This thrombosis adds to the gravity of the disease, and its danger is apparent when we remember the proximity of the

PLATE VII.

The under, caudal, surface of liver and g[illegible] entering the lesser peritoneal cavity through the foramen of Winslow.

[illegible], produce the greater [illegible] we are called upon clinically [illegible].

[illegible] enter the peritoneum from a septi- [illegible] is the [illegible] bacillus in acute [illegible] the pneumococcus, the gono- [illegible] occasionally in females. [illegible] organisms that come from the [illegible], not the intestinal tract, [illegible] in pyosalpinx, the [illegible] of the mesenteric [illegible] disease of the spine, and [illegible] streptococcus in cases of [illegible], perinephritic abscess [illegible] wound of the abdominal wall.

[illegible] reaction of the peritoneum to infection de- [illegible] the character and quantity [illegible] first effect of a peritonitis [illegible] bacillus is the effusion [illegible] which results in [illegible] between opposing peritoneal [illegible] agglutination is more rapid when [illegible] and [illegible], and slow or [illegible] when the effusion is rapid and serous. The [illegible] surfaces are at once swollen and turgid; the [illegible] greatly enlarged, and the subserous [illegible] increased to an enormous extent. The [illegible] blood-vessels frequently undergo such [illegible] that a thrombosis, at first mural [illegible], takes place. This thrombosis [illegible] of the disease, and its danger is [illegible] remember the proximity of the

PLATE VI

The under, caudal, surface of liver and gall-bladder, showing entrance to lesser peritoneal cavity through the foramen of Winslow.

intestinal and mesenteric blood-vessels to the peritoneum. The underlying muscles of the intestinal tract are paralyzed by the infiltration of their sheaths, and peristalsis stops, resulting in obstruction of the bowels. The mesenteric and other lymph tissues are engorged with serum, and afterwards with infectious material, and they sometimes become, in circumscribed peritonitis, the site of real abscesses, which may remain after the peritonitis has been relieved by surgical measures.

The rapidity and course of a peritonitis due to the tubercle bacillus is slower, while that due to the invasion of the streptococcus is more rapid; and there are doubtless grades of virulency for these two and for all other microörganisms.

Since the peritoneal cavity is a single, open, and practically continuous space, the artificial division of peritonitis into local and general, circumscribed and diffuse, is merely a matter of pedantic convenience and not of clinical significance. It is a fact that many cases of peritonitis become in the course of time circumscribed by adhesions, but this peritonitis was at first diffuse and uncircumscribed and liable at any moment to become general. Nevertheless, it is convenient for us to say that a peritonitis is general, and from a clinical standpoint it is therefore fatal unless it be due to the tubercle bacillus. It is convenient to say in another case that a peritonitis is diffuse and occupies an unbounded and unlimited portion of the peritoneal cavity, but fails to involve it in its entirety, and it possesses the possibility of becoming circumscribed by adhesive processes. It is convenient in

another case to say that the peritonitis has become circumscribed; that it occupies a definite and limited portion of the peritoneal cavity, and that the remainder of the peritoneal cavity is free from infection. With these limitations the terms are used in this discussion.

Again, the character of the effusion or absence of effusion gives the peritonitis certain appellations. If it is free from liquid effusion it is said to be a dry peritonitis, peritonitis sicca; if it is a peritonitis in which fibrin is extruded, it is called a fibrinous peritonitis. If serum is transuded, it is called a serous peritonitis. When pus is formed from the effusion, it is called a suppurative peritonitis. The result of a peritonitis sometimes determines the appellation. When the peritonitis results in adhesions, it is called an adhesive peritonitis. When it limits the extension of the infection, it is called a limiting peritonitis. When it obliterates a peritoneal fossa or pouch, it is called an obliterating peritonitis. Most of these limitations are obvious and require no explanation or definition, but they must be understood as relative and as artificial categories into which only a small number of typical cases permit themselves to be classified.

As remarked at the beginning of this chapter, peritonitis is interesting to the physician and surgeon only so far as its prevention is possible or its course is limitable. The treatment of peritonitis is a short and melancholy chapter and confined entirely to the treatment of the localized or not extensively diffuse disease. The question which at once arises

in the mind when symptoms of peritonitis appear is, "From what point or atrium did this peritonitis arise?"

The most obvious though one of the rarest doors through which the etiologic factor of peritonitis enters is a defect in the abdominal wall, or an opening between the gastrointestinal tract and the general peritoneal cavity. Stab wounds, gunshot wounds, and other penetrating wounds of the abdominal wall give entrance to the pathologic microörganisms, which set up a peritonitis. The same result follows from a ruptured or perforated intestine or other viscus. Such a defect is usually plainly indicated and perfectly obvious.

The most common source of peritonitis, especially in the male and in children, is the vermiform appendix. Probably two-thirds of all cases of peritonitis, in these subjects at least, arises from the spread of an intraappendicular infection to the periappendicular peritoneum.

The second most common source of peritonitis is confined entirely to adult females, and is limited to the uterus and Fallopian tubes. In the former the infection is usually of a puerperal origin, while in the latter instance it is due to gonococci, with possibly a later mixed infection.

Probably the third site of a beginning peritonitis is the region of the gall-bladder and common duct. Here the peritonitis may be due to the spread of an intracystic inflammation to the pericystic peritoneum, or it may be due to infection about a stone in the common duct and the spread or dis-

charge of the infection into the cephalic peritoneal cavity.

The other sources of peritonitis are of uncertain frequency. The stomach and duodenum are occasionally perforated by ulcers; abscesses occasionally appear in the liver and break into the peritoneal cavity; intussusception, carcinoma of the intestine, infarcts of the spleen, and other viscera give rise to peritonitis; loops of intestine become strangulated in the inguinal ring, the foramen of Winslow, the duodenojejunal fossa, the obturator foramina, or through abnormal defects in the region of the umbilicus or the diaphragm. Ulcers of a tuberculous or typhoid origin rupture into the peritoneal cavity, and suppurating lymph glands in the mesentery or abdominal wall give way. Prostatic abscesses and perirenal abscesses, or even abscesses arising from the kidneys, the vertebra, or the abdominal wall break into the general peritoneal cavity and give rise to the terminal disease. In the course of marasmus thrombi form in the mesenteric vessels, and the tributary gut is quickly rendered necrotic and infected. In the course of endocarditis and pyemia, and especially in the course of puerperal sepsis, infected emboli may produce infarcts in any of the blood-vessels tributary to the peritoneum.

The diagnostician and clinician must not confound his judgment of the probabilities in any case by the multiplicity of possible sources of peritonitis.

SCHEME OF SOURCES OF PERITONITIS

(1) Wounds of the abdominal wall.
(2) Wounds of the intestinal tract.
(3) Diseases of the intestinal tract:
    (a) Ulcer of the stomach; (b) ulcer of the duodenum; (c) cholecystitis; (d) cholangitis; suppurative pancreatis; (e) perforating typhoid ulcer; (f) perforating tuberculous ulcer; (g) appendicitis; (h) intussusception; (i) strangulated hernia; (j) carcinoma of the intestine, colon, or stomach; (k) inflammation of Meckel's diverticulum; (l) obstruction of the bowel by volvulus.
(4) Diseases of the genitourinary tract:
    (a) rupture of the urethra; (b) prostatic abscess; (c) endometritis and metritis and thrombosis; (d) salpingitis; (e) rupture of the urinary bladder; (f) ruptured extrauterine pregnancy; (g) pyonephrosis; (h) infarcts of the kidney; (i) perinephritic abscess.
(5) Diseases of the solid viscera:
    (a) Infarcts and abscesses of the spleen; (b) infarcts and abscesses of the liver; (c) infarcts and abscesses of the pancreas.
(6) Diseases of the blood-vessels:
    (a) Thrombosis and embolism going out from the genitourinary tract in women and from the perirectal tract in both males and females; (b) thrombosis and embolism of the mesenteric vessels; (c) thrombosis and embolism going out from the naval in the new-born; (d) hemorrhagic pancreatis.
(7) From suppuration in adjoining serous cavities.
    (a) From the pleural cavity; (b) from the pericardial cavity; (c) from the tunica vaginalis testis.
(8) Pyemic infection from endocarditis or other systemic infection.

The clinical picture of an acute peritonitis is one with which the physician becomes mournfully familiar. It is most striking and characteristic. Even the

appearance of the patient's face and the attitude of the body are enough to establish the diagnosis at the first glance of the experienced clinician. The patient is supine, fixed, immovable, and with the knees drawn up, the head and shoulders thrown forward, and the arms in an attitude of protection. The face is thin, pinched, and the nose appears sharp. The eyes are sunken; the color of the skin is pale but smoky; the lips are red, and the brow is covered with a cold sweat. When the abdomen is exposed the abdominal muscles are rigid, and at first retracted, and later distended to the utmost. The respirations are wholly costal and rapid in proportion to the distention of the abdomen and the amount of shock or cyanosis. The pulse from the very first is excessively rapid, 104 to 160 to the minute; it is weak and almost imperceptible at the onset of the disease and during the persistence of shock, but later it becomes full and bounding. The temperature is often carried over from the primary source of the peritonitis, but it usually falls as soon as the peritonitis begins, and often leads to a false hope of a betterment of the condition of the patient; (the cross of the curves.) When the peritonitis is rapid; virulent, and diffuse, the temperature is often very high, especially in puerperal sepsis, reaching 104 to 106.

The voice of the patient is remarkably changed, and is at first weak and restrained, and finally becomes harsh and ringing. The mind remains clear usually to the last, or when the temperature is very high a mild and consistent delirium, with vivid illusions, prevails. Toward the end the patient has a delightful

sense of well being, which betokens euthanasia. The face becomes cyanotic, the extremities cold, and the body is covered with a cold sweat.

The onset of the peritonitis is usually marked by the sudden appearance of dreadful abdominal pain. This pain is of such a nature that it is to be mistaken only for the passage of a biliary or urinary stone. It is so agonizing and terrible that the physician is tempted to at once administer morphine or an anesthetic. From that time on the pain is constant, with frequent exacerbations. The pain begins to subside only after the effusion has become considerable and the toxemia has produced an anesthesia of its own. Every effort at inspiration produces pain, which limits the motion of the diaphragm. The patient can hardly endure the slightest touch over the abdomen, and the movements of the bed and bed-clothing produce a distress which can hardly be understood by the attendants.

With the onset of pain there appears as a rule a violent attack of vomiting. At first the contents of the stomach are discharged, then later in the course of the disease the water which the patient is constantly calling for, and bile-stained mucus are thrown up, and last of all, when the obstruction of the bowels through paralysis has become complete, the patient throws up fecal smelling vomitus or even fecal matter itself. Any time during the course of the disease the highly congested mucous membrane of the stomach exudes blood, and this gives rise to the black vomit which is so ominous to the laity. Every attack of vomiting produces an exacerbation of the

abdominal pain and leaves the patient cynotic, dyspneic, and covered with a cold sweat.

From the very beginning of the peritonitis the intestinal muscles are paralyzed, and there is complete obstipation, and even the passage of gas is arrested. No amount of enemas does more than empty the lower bowel, and every enema and every attempt at catharsis produces an increase in the pain. Even the introduction of a few ounces of fluid into the colon is followed by a reverse peristalsis, which carries the fluid upward to the site of obstruction. This event is marked by an agonizing colic, which slowly subsides.

The urine during the whole course of the disease becomes scanty and more scanty, and contains a larger and larger quantity of the normal constituents, with a very great increase in the quantity of indican, and at last a growing quantity of albumin and many granular and bloody casts. The presence of albumin, casts, and blood in the urine must be looked upon as one of the gravest manifestations of a localized or diffuse peritonitis.

The effusion into the peritoneal cavity comes on usually with great rapidity after the onset of the disease. Sometimes, however, the infection is so virulent that the intestines become covered quickly with a congested serosa almost like a veil of granulation tissue, and then only a small amount of bloody, stinking serum is found in the pelvis at the autopsy. The tenderness of the abdomen and the distress of the patient at every effort to palpate or percuss the abdomen makes any serious attempt to determine the amount of the exudate clinically impossible. A rectal

or vaginal examination, a light palpation of the abdomen with most careful percussion of the flanks, and an ausculatory percussion, especially over the liver and stomach, is all that can be attempted. No effort should be made to determine by palpation the original site or atrium of the disease. If the absence of liver dullness gives rise to the suspicion that the abdominal cavity contains free gas, it may speak for a perforation of the intestinal tract, or for the improbable presence of gas-forming bacilli in the effusion.

The course of the disease is so short that the examination of the blood shows variation only as concerns the leucocytes. While the leucocytosis may have been very moderate, 8,000 to 12,000 to the cmm. during the course of the primary disease, the metritis, the salpingitis, the appendicitis, or the cholecystitis, or even below normal during the course of the typhoid, as soon as the peritonitis is initiated, the number of leucocytes increases with tremendous rapidity, until it reaches 30,000 to 60,000 to the cmm.

The natural tendency of infection within the peritoneal cavity, from whatever atrium it comes, is toward a rapid, diffuse, or general dissemination, until all the peritoneal surfaces are involved. There are many elements or factors which contribute toward this end, and only a few that tend to limit the spread of infection. (1) The natural capillary attraction between the peritoneal surfaces results in a rapid spread of the effused and infected lymph about, for example, a defective appendix. If the surfaces of two microscope slides are brought together and the edges touched to a drop of ink or colored fluid, the drop

spreads rapidly in every direction until all of the opposing surfaces are stained. This happens upon peritoneal surfaces whenever infected lymph is poured out into the peritoneal cavity. (2) The peritoneal surfaces are unlike the rigid surfaces of a glass plate in this respect that they are for the most part in constant motion. The peritoneal surfaces of the intestine undergo peristaltic movements, carried on by the muscles of the gut. This movement is increased by the presence of food in the stomach, by the use of purgatives, and is diminished by the use of opiates and by the toxemia of the infection. (3) The diaphragm is in constant motion and communicates aggressive and recessive movement to every organ and viscus of the abdomen from the liver to the bladder and uterus itself. By this constant swinging of the viscera infection is spread from one surface to another. (4) The action of gravity causes an effusion to spread from a higher to a lower part of the abdominal cavity, and this influence is changed with every change in the position of the body. (5) Last of all, the extent of the effusion naturally results in the spread from one locality to another, and this factor prevails even when the limiting factors have exerted themselves to the utmost. It is hardly worth while to mention a number of other factors which result in the spread of infection, such as vomiting, the distension of the bowel above a completely paralyzed gut, the formation of capillary thrombi, the disintegration of infected effusions of lymph and fibrin, and the spread of the infection as a lymphangitis.

The factors which result in the limitation of infection are less numerous and less efficient. (1) The most important limiting factor is the production of a fibrinous, adhesive peritonitis, somewhat in advance of the infection, the result of a toxemia carried through the subperitoneal lymph channels. In some forms of peritonitis this effusion does not appear. The surfaces of the peritoneum remain covered with liquid effusion, and no tendency is shown toward adhesions between the peritoneal surfaces, while every movement of the intestine and of the body spreads the infection. Adhesive peritonitis appears only when the effusion is small or slow. The formation of adhesions requires time, and when the inflammatory process is too rapid it is not present, or it is limited to small areas of motionless peritoneum. (2) The paralysis of the bowel produced by the contact of infected effusion is a strong limiting factor in peritonitis. It is probable that this occurs quite early in the course of the disease, and that it assumes a grave form resulting in obstruction of the bowel at a somewhat later time. (3) The relatively motionless omentum is a factor which tends to limit the spread of the infection, and it specially shuts off the cephalic from the caudal peritoneal cavity. It also lies over the ileocolic fold and frequently adheres to it, shutting off the ileocolic from the ileocecal fossa. (4) The intestinal mesenteries and mesocolon are anatomic factors which limit the spread of peritonitis.

Everything which tends to diminish the activity of the factors which cause an extension of the peritonitis may be looked upon as factors limiting its spread.

The pain which results secures the utmost quiet of the patient, and the rigidity of the abdominal walls, and the arrest of movements of the diaphragm somewhat lessens the activity of the bowels. The toxemia, again, lessens the discomfort of the patient and quiet follows where agitation might be expected.

In the great majority of cases the diagnosis of peritonitis is simple, prompt, and easy, but there is a series of cases in which from the prominence of one set of symptoms or the absence of another the diagnosis may be obscure, and nothing but a laparotomy or a lapse of valuable time can make the picture clear. The pain of a peritonitis may be mistaken for renal colic, for biliary colic, for lead colic, the crises of locomotor ataxia, for an acute enteritis, for ruptured ectopic pregnancy, for hysteria, for an obstruction of the bowel by hernia or intussusception, for an ovarian tumor with twisted pedicle, for acute dilatation of the stomach, for pancreatitis and fat necrosis, or for a pleuritis or a pericarditis, not to mention the traditional neuralgias of the stomach and peritoneum.

The obstruction of the bowel may be referred to volvulus, to hernia in one of the retroperitoneal pouches, such as the duodenojejunal pouch, the ileocolic pouch, the ileocecal, the retrocecal, or sigmoid pouch, or through an artificial foramen, such as the obturator foramen, the sacrococygeal foramen, the inguinal ring, the umbilical ring, or any number of places where defects occur in the diaphragm and abdominal wall. It may be referred to an impacted fibroid or ovarian tumor, or to adhesions about the stump where such tumors have been removed, or other abdominal

surgical operations have been performed. It may be looked upon as a case of intussusception in the young or carcinoma of the colon in the old. If an abdominal tumor presents itself with the obstruction, it may be looked upon as a case of fecal impaction or obstruction of the ileocecal valve with an enterolith.

The toxemia of peritonitis may be mistaken for typhoid, for uremia, for malarial or diabetic coma, for cerebrospinal meningitis, for acute miliary tuberculosis, septicemia, and pyemia.

The distention of the abdomen may be mistaken for gaseous distention due to constipation or fermentation of the intestinal contents, to sudden appearing hysteric distention, and to acute dilatation of the stomach. In patients suffering from chronic nephritis, it may be mistaken for an acute effusion, which sometimes appears as a terminal disease; or it may be looked upon as the result of embolism or thrombosis in the mesenteric vessels in typhoids or persons suffering of amebic disease or anchylostomæ duodenalis, or to ascites from cirrhosis of the liver or lesions of the heart.

The treatment of a traumatic peritonitis without infection is a matter of pure symptomatic palliation. The natural tendency is toward complete recovery, or recovery with few or many anatomic defects, which may themselves require subsequent surgical treatment.

The treatment of peritonitis due to chemic irritation cannot be so simply stated. If the chemic irritation is a ruptured urinary bladder, immediate surgical repair is absolutely indicated. If it is due to

a ruptured ovarian cyst, it is possible that the patient may survive, and the conditions may be such as to make expectant treatment permissible. If the peritonitis is due to a ruptured extrauterine pregnancy, the indications for a laparotomy are positive.

The treatment of a suppurative peritonitis, or an infectious peritonitis not of tuberculous origin, and presumably due to pyogenic germs, has long been a field of contention between physicians and expectant treatment on the one hand and surgeons and radical treatment on the other hand. The physicians have multiplied remedies and methods of administration, but they have failed to make possible an exclusive and absolute diagnosis of the kind and extent of the peritonitis. If I may be allowed to reduce their method of treatment to the simplest terms, I should say that it consisted in two sorts: (1) extreme purgation by the use of remedies by the mouth or anus, and (2) its antithesis, the locking up of the bowels and the paralysis of their peristaltic motion with opium and kindred drugs.

The former method prevails among gynecologists and obstetricians, and seems to have gradually receded until it now finds its field only in such forms of peritonitis as arise from sources outside the intestinal tract, and especially from the Fallopian tubes and the uterus. Even among gynecologists it is relied upon not as in any way curative, but only designed to relieve the acute manifestation of the disease and separate by death the operable and hopeful from the inoperable and grave cases. A full argument in favor of the use of saline cathartics and accessory measures

in peritonitis is given in Anders's Practice of Medicine, 6th edition, page 829.

Fearing obstruction of the bowels due to the peritonitis, large quantities of concentrated solutions of magnesium sulphate or Rochelle salts are given by the mouth, or injected into the rectum, to produce rapid liquid discharges, to keep the intestines in an active state of peristalsis, to dehydrate the peritoneal cavity, and to reduce the hyperemia of the intestines. It is perfectly clear that if this effort is successful the most active factor in the dissemination of the infection is exaggerated. If there is an infectious material in the free peritoneal cavity, it is certainly spread. If obstruction has occurred before the administration of the purgative, it only adds to the suffering and to the danger of the patient.

On the other hand, the use of opium has been recommended by physicians, and combated by surgeons, in all cases of peritonitis arising from the intestinal tract and its appendages. The opium is given with the idea that by its use one of the most prominent symptoms, namely the pain, is relieved, and one of the greatest dangers, namely the spread of the infection through the peristaltic movements of the bowels, is diminished. The utmost quiet and composure of the patient is thus secured, and time is given for adhesive peritonitis to occur and limit the spread of the disease. Usually from one-third of a grain to a full grain of morphine is given hypodermically every two hours as long as the pain calls for it; but in some cases enormous quantities have been given, amounting to 18 to 200 grains of opium a day. Nothing

can be more disastrous than the use of opium in a peritonitis, the source of which has not been definitely fixed or the extent of which has not been positively determined. From the standpoint of the surgeon opium should be used in peritonitis only to relieve pain after operation, or to promote euthanasia when operation is impossible.

The more empirical, and therefore the less scientific, the medical body, the more positive are its statements for the use of one or another therapeutic measure for peritonitis. The homeopathists have a long list of dilutions and triturations which are influential, effective, and curative in all stages of peritonitis. The osteopathists and hydropathists find unfailing methods in their several arts, and even in the regular profession the bishops and cardinals and popes of extensive practice proclaim ex cathedra unfailing methods of limiting the spread of infection and of killing the microorganisms in peritoneal effusions, by lavage, starvation, enemas, and the poulticing of the abdomen in concentrated solutions of boric acid and alcohol. These methods are alike in their irrational basis and pernicious results. They not only kill the patient, but they promote careless diagnosis, faulty if not fallacious methods of reasoning, and calamity to the interest of patient and profession.

The surgical treatment of a diffuse, general peritonitis is a hopeless proceeding which the surgeon is obliged to undertake in order to preserve his own sanity and scientific composure in spite of its almost invariably fatal termination. Theoretically and practically every case of general suppurative peritonitis

can be more disastrous than the use of opium in a peritonitis, the question has not been definitely fixed or the extent of which it may be positively determined. It is a safe statement, one of the surgeon opium should be used in peritonitis only to relieve pain after operation, or to produce euthanasia when operation is refused.

The more radical and therefore the less scientific, the methods of treating the suppurative stages of peritonitis by operation or other therapeutic measures for the relief of symptoms have all been tried, and are infallible, effective, and useless in septic peritonitis. Homœopathists and physicians of all schools of medicine, on their several grounds, object to the regular profession the bishop's usual popes of extensive practice proclaim various methods of limiting the spread of infection and of killing microorganisms in purulent effusions, by the use of starvation, enemas, and the sprinkling of the abdominal contents with concentrated solutions of boracic acid and alcohol. Each of these methods are at best irritating and have produced disastrous results. They not only kill the patient, but they promote careless diagnosis, false hopes, false estimates of reasoning, and calamity to the interests of the profession.

The surgical treatment of a diffuse, general peritonitis is a hopeless proceeding which the surgeon should not undertake in order to preserve his own reputation for competence in spite of its ultimate destructive termination. Theoretically and practically every case of general suppurative peritonitis

PLATE VII

Half-tone from a photograph of a woman suffering of a diffuse peritonitis in the caudal peritoneal cavity. This photograph was made during violent peristaltic movement of the bowels in the upper or cephalic portion of the peritoneum. (From a patient of Dr. Weller Van Hook.)

terminates fatally. When, however, the diagnostician has made the relative diagnosis of a diffuse general suppurative peritonitis, the establishment of adequate drainage through the abdominal wall and through the vagina with the obliteration of the atrium of infection, frequently results in recovery. This recovery, however, does not change the theoretical and clinical rule, but simply casts doubt upon the possibility of making an absolute diagnosis of general peritonitis. It may be possible, too, that the resisting power of the tissues of the patient or the self-limited nature of the course of the infection, dependent upon the life history of the microbe, may have something to do with the favorable result. The more liquid the effusion and the less fibrinous, the better the chances are that drainage will be effective. It is impossible to conceive of any adequate drainage when the intestines are covered over a great part of their extent with infected fibrinous exudate.

Some operators have opened the abdomen, found extensive suppuration, sewed up the defect in the gut, removed the appendix or gall-bladder, and then washed with infinite care and enormous quantities of aseptic or antiseptic solution the inflamed and lymph-covered intestines, and have then replaced them, either with or without drainage of the caudal peritoneal cavity, and in a few cases recovery has followed. It would seem that the cephalic peritoneal cavity was not affected in these cases, and that the whole of the caudal peritoneal cavity was either relieved of the bulk of its infection by the operation or by the drainage. Such a procedure as this was described by the

younger Johns Hopkins men in 1897, and has been practiced occasionally by gynecologists and operators with now and then a successful issue. In my own experience most remarkable recovery has followed adequate pelvic drainage, but under no circumstance after the demonstration of a general fibrinous exudate in a general suppurative peritonitis has recovery followed.

The treatment of a supposed general peritonitis consists in such a laparotomy as will lead to the most likely atrium of the infection—to the appendix, to the gall-bladder, to the female genitalia, or to the wall of the stomach in cases of perforating ulcer of the stomach. When the effusion is approached, it is allowed to run off, and the space from which it flows is carefully sponged out with hot, moist, antiseptic sponges, which are immediately thrown away. When all fluid exudate has been removed with the greatest precaution against disturbing the relations of the intestinal wall of the abscess, the intestines are held cephalad or lateralward, with a broad, thick abdominal sponge in such manner as to give access to the supposed atrium of the infection. This is treated when possible by a suitable method, closure of the ulcer, removal of the appendix or drainage and closure of the rupture of the gall-bladder, and drainage is made through the abdominal wound and the vagina in females, and through the abdominal wound alone or through the abdominal wound and the rectum in males. This drainage consists in the introduction of a perforated tube of India rubber ten or fifteen inches long and an inch in diameter. This tube is surrounded

with a large drain of antiseptic gauze either introduced with a Mikulicz protecting handkerchief, or with long strips, the ends of which hang over the abdominal wall. When the strips are introduced, great pains is taken to place one in each of the fossæ of the caudal peritoneal cavity, one in the subcecal fossa, one in the ileocecal fossa, one in the ileocolic fossa, and one or more in the pelvic and left ileocolic fossæ. In rare instances it is necessary to drain other abdominal fossæ. The ends of these strips are collected together and marked, either with tags or knotted silk thread, so that the last to be inserted may be first removed. The patient is kept in the semi-recumbent position, the opposite of the Trendelenburg, during the whole course of the operation, and when the drainage is thoroughly instituted the upper portion of the incision in the abdomen is closed in the usual manner. The vagina should be tamponed so as to allow liberal drainage from the tube without danger of infection, or the anal sphincter is paralyzed and the anus partially filled with gauze protecting the tube into which gauze orthoform has been incorporated, to relieve the pain in the rectum. A rectal tube should be left by the side of the drainage tube to carry away the gas and prevent any infectious material from being forced into the peritoneal cavity.

After the application of a liberal absorbent dressing over the abdomen and perineum, the patient is put to bed in a semi-recumbent position, and given a liberal subcutaneous infusion of normal salt solution. The pulse, the temperature, the character of the urine, and the number of leucocytes in the blood, are

carefully watched for indications of a favorable termination. If vomiting continues, and if the pulse remains rapid, if there is great anxiety and sleeplessness, if albumin and casts appear in the urine, if gas fails to pass the rectum, and if the leucocytes continue to increase in number, the progress of the disease has not been arrested, and the prognosis grows more and more grave. If the patient sleeps, if vomiting disappears, if the urine is abundant and the pulse relatively low in spite of a high temperature, a guarded prognosis, with a hopeful inflection, may be given. There is no time from the end of such an operation to the end of the second week when an unqualified favorable prognosis can be expressed. The danger seems to diminish when the fifth or sixth day has passed without positively unfavorable manifestation. Most of the patients die either at the end of the first twenty-four hours or between the fourth and sixth day. Should the patient survive the fifth day, it will be necessary to begin to remove the tampons, or to irrigate the drainage tube with a mild antiseptic, or even to do both these things. The gauze is removed by carefully moistening the presenting part of the last introduced roll with an antiseptic solution, and then with the utmost care detaching it by a slight pull toward the right and then toward the left from the edges of the abdominal wound. This gentleness must be practiced not so much to save the patient the pain and the dangerous movements of the body which might result from it as to obviate any breaking up of adhesions between the viscera surrounding the tampon. The greatest skill and appreciative judgment must be

used in every slightest movement of the gauze in the course of its extraction. All the gauze ought to be removed by the end of the eighth or tenth day, but under no circumstance should it be extracted with any violence. After the removal of the last pieces of gauze the abdominal wound must be kept open with smaller strips of gauze or with a tube. These must be removed daily and the suppurating sinus kept clean with suitable irrigation. Sometimes these sinuses are very prompt in closing, and at other times they endure for weeks and months, especially if they are connected with the interior of the bowel.

The treatment of a diffuse peritonitis is always conducted upon the presumption that it is a general peritonitis, and the methods of treatment are not different in any particular except when they are limited by the greater probability that this diffusion is limited to a smaller area of peritoneum. When the uterus is the source of the infection, no attempt would be made to drain the cephalic peritoneal cavity or even the ileocolic fossa. If the appendix is the source of the infection, the drainage may be confined to the pelvis, the subcecal, the ileocecal, and the ileocolic fossæ. If it is a perforating ulcer of the stomach, then the drainage would naturally be confined to the cephalic peritoneal cavity.

All operators agree that there is no expectant treatment of peritonitis; that the prime imperative duty of the attendant is to remove or obliterate the source of peritoneal infection at the earliest possible moment, remove the disseminated infection as completely as possible, and place the peritoneum and the patient in

the best possible condition for recovery. There is practical unanimity in the immediate removal of the source of infection. Whatever the other conditions are, the chances of recovery are better with the offending appendix removed or the leaking and perforated ulcer closed than if left undisturbed. The only added risk is the traumatism of the operation. As Joseph A. Blake remarks: "I think that any of the advocates of the treatment by rest will concede that the patient would be much better off with the appendix out if it could be done without an operation. We have simply to weigh the dangers of the additional toxemia of the anesthetic and the shock of operation against the danger of continued infection, both systemic and peritoneal, from the appendix itself or the escape of its contents."

In regard to the next proposition, namely, the removal of the escaped infection, two methods are followed, the dry method and the method of irrigation. The former is slower and probably less complete; the latter is more rapid, but frequently results in the further dissemination of the infection. In the hands of some operators it has been practiced with remarkable success. It has always seemed to me a dangerous procedure. It is probably necessary when drainage is not used.

In regard to the last proposition, namely, the placing of the peritoneum in the best condition for recovery, there are two very divergent opinions which must be considered—the one is drainage, which all operators concede is necessary in some cases, and the other is complete closure without drainage, a method which

has produced remarkable results in the hands of some operators. I have changed my opinions and practices in antiseptic surgery too often to deny the possibility of another change, and yet I have never had the hardihood to close up a diffuse suppurative peritonitis after the most complete primary disinfection which I could accomplish and the satisfactory removal of the source of the infection. I am ready to concede that it is desirable to avoid drainage, I admit that the peritoneum has unequaled power of destroying infection, and I recognize that in certain cases I have seen most remarkable germicidal power exercised in this cavity; nevertheless, while admitting the reliability of all that has been published by the advocates of closure of the peritoneum, I still practice this treatment, so undesirable and so prone to encourage complications.

One of the most threatening symptoms of a general peritonitis, or even of a local diffuse peritonitis, is intestinal obstruction due to the paralysis of the muscles of the intestine by the adjoining infection. The obstruction in often so complete, the distention of the gut above the obstruction so excessive, that no amount of drainage is sufficient to overcome it. It is then necessary to treat the obstruction and distention as a secondary condition from an etiologic standpoint, but as an imminent and immediate indication for treatment. The gut must be brought into the wound and a temporary artificial anus formed to allow the discharge of feces and gas and permit the overdistended gut to collapse. This artificial anus adds greatly to the horribly mutilating and disgust-

ing treatment. It increases the suffering of the family, but gives the only possibility of recovery to the patient. As a rule it closes in the course of a few weeks, or it remains and must be treated surgically.

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No subject has given rise to so extensive, so worthless, and so discouraging a literature as peritonitis. From the time of Hippocrates to the present, there has been but little change in the quality and no diminution in the quantity of effusions upon this subject. Little of it is worth mentioning, and much of it is unworthy any serious perusal. Up to 1889 a list of most of the articles upon this subject may be found in the Index Catalogue of the Library of the Surgeon General's Office, Vol. 10, pages 941 to 961, inclusive, and in other parts of this catalogue. A very complete bibliography of the more modern and more important literature was published by Max von Brunn in the Centralblatt für Allgemeine Pathologie u Pathologische Anatomie, January 22, 1901, Vol. 12, No. 1 et seq.

This article gives very valuable information upon the etiology, pathology, and course of various pathologic and clinical forms of peritonitis. The literature is classified and arranged in chronological order, but makes no attempt to be exhaustive.

Another selection of interesting literature is to be found in Nothnagel's Cyclopedia, Die Erkrankungen des Darms und des Peritoneum, Vienna, 1898, pages 794 to 814, inclusive.

The current literature can be studied in Gould's Year Book, Head's Practical Medicine Series, and other similar annuals.

CHAPTER IX

INTUSSUSCEPTION

The condition described; relative frequency as concerns age and sex; etiology; typical case; symptoms; diagnosis; prognosis; treatment; the operation described; complications; cases; bibliography.

The physician is often required to treat a sudden and severe disease in children in which the greatest expedition is necessary, and in which the possibility of a favorable termination depends largely upon the issue of the first twelve hours. During the first months of life, and in children suffering of marasmus or intestinal disorders, and even in apparently healthy children, an intussusception, or invagination, or telescoping of the bowel is a relatively common disease. In 1,000 operations for intestinal obstruction Gibson found 187 cases of intussusception. In 295 cases of acute intestinal obstruction Fitz found 93 due to the same cause; 52 males, 41 females. Of these cases 34% were in children under one year of age, and 56% in children under ten. In 50% of the 103 cases of intussusception collected by Wiggins, the maximum age limit did not exceed six months.

There is no disease of the abdomen in children so easily diagnosed as intussusception. The onset is so sudden, the symptoms so pronounced, that in the great majority of cases, without subjective symptoms,

the diagnosis is easy. Similarly there is no disease of children in which surgical interference is so necessary or so effective.

An intussusception is the result of the passage of an oral portion of the gut into the adjoining anal portion, or if we accept the evidence of repeated laboratory experiment, it may more precisely be expressed as the reflection, by a reverse peristalsis, of the anal portion of the gut over the adjoining oral segment. In either event the condition produced is the same, and it is tritely but not inaptly compared to the partial invagination of the finger of a glove. (Fig. 36.) As produced in laboratory animals it is dependent upon purely physiologic causes.

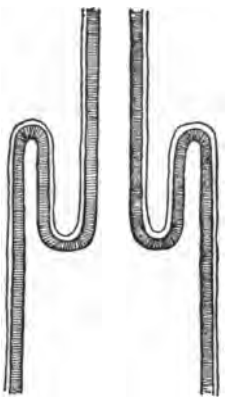

Fig. 36.

The pathologic invaginations are the only ones demanding clinical attention. As a rule they are single in children, and there is no anatomic condition known to precipitate them. In adults they are frequently due to tumors of the mucosa or the muscularis of the intestine. In children they occur in such a way as to involve the ileum within a few inches of the ileocecal valve, or the valve itself, together with portions of the ileum and colon. Seventy per cent of all cases are of the ileocecal variety. The theories of invagination are of little clinical importance. The anal portion of the gut involved in the process must become distended, while the oral portion, as it is

received into the advancing intussusceptum, carries its proper mesentery along with it, thus adding to the general bulk of the contained tissues, and providing

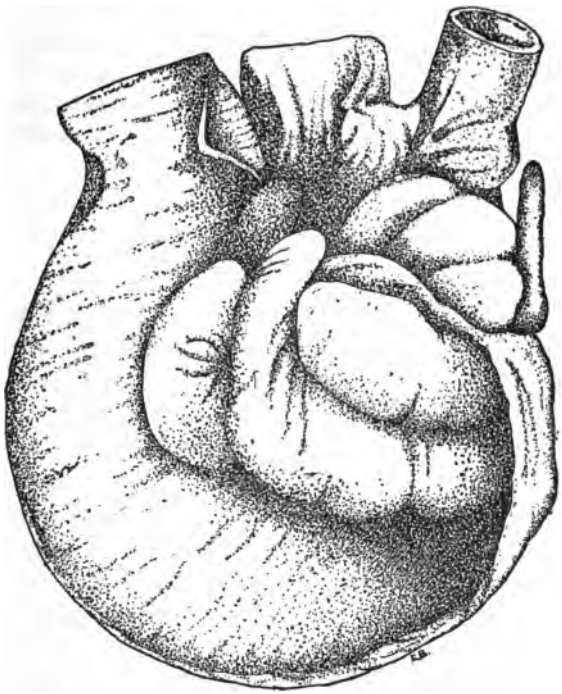

Fig 37.

an impediment to its circulation which is of the nature of the "vicious circle." (Figs. 37 and 38.) The obstruction of the venous circulation, which is the first to occur, results in an edema of the intussusceptum. It becomes greatly swollen, and is thus the more se-

curely held in place. The violent peristaltic action of the bowel produces abrasion of the mucous membrane of the intussusceptum, indicated by tenesmus and by the passage of a bloody mucus. In from twelve to twenty-four hours these abraded areas become invaded by microörganisms, and infection is added to the complex. The obstruction of the mesenteric circulation becomes more complete, and necrosis and gan-

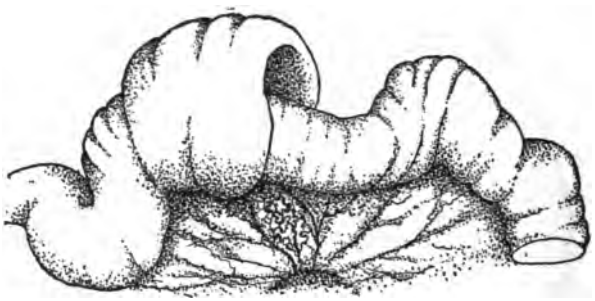

Fig. 38.

grene of the involved gut ensue. If firm adhesions have formed between the peritoneal surfaces of the intussuscipiens and the intussusceptum, the gangrenous segment of the gut may be passed off together with portions of the mesentery. In this way recovery is said to occur in a few cases, especially in vigorous youths and in adults. As a rule, however, infection of the surrounding peritoneum occurs in from twelve to twenty-four hours following the attack. The intussusception is then characterized by the onset of febrile symptoms, and may during this stage be mistaken for an appendicitis. With the initiation of

infection ends the period for favorable operation, and to the treatment are then added all the difficulties of a local peritonitis.

It is a well-recognized fact that males are more subject to intussusception than females. In Gibson's collection of cases 72% were in males, and 28% in females.

The etiology of intussusception is far from being clear. In more than one-half the cases recorded no assignable cause for the disease was discoverable by the best observers. Fitz states that in 42 out of 45 cases there was no evident exciting factor, although, in the lack of more positive findings, etiologic significance might have been conceded in 12 of these cases to diarrhea, in 12 to chronic constipation, in 7 to protracted abdominal pain, in 6 to the taking of indigestible food, in 4 to violent exertion, and in 3 to trauma. Individual cases occurred in typhoid fever, in variola, in gastroenteritis, in pregnancy, and one followed the administration of cathartics after an operation for incarcerated hernia.

The history of a typical case of intussusception is somewhat as follows: The patient is a little boy less than a year old. He has been fed for a few weeks on some artificial food. He is suddenly seized by a fit of violent crying and refuses to be comforted. The appearance of the child alarms the mother, and a physician is called. By the time of his arrival the child is in a profuse sweat from protracted crying and has perhaps fallen asleep from exhaustion. The physician fails to recognize any cause for the mother's anxiety and fails also to make any palpation of the

child's abdomen for fear of waking him and exciting another paroxysm of crying. He leaves some placebo for the little patient, and recommends an enema. Perhaps he discovers that the child has been suffering of a diarrhea, and prescribes an intestinal antiseptic, with possibly some small dose of opium. No sooner has the physician left the house than the child awakes with another and more agonizing crying spell. The mother makes a vigorous search for pins, and discovers that the child has had several scanty movements of the bowels, in the last of which, only three or four hours after the onset of the attack, there are evidences of blood. The child's anus protrudes, and all the abdominal and perineal muscles are violently contracted with tenesmus. Now for the first time the little boy vomits, and this act is often repeated during the succeeding course of the disease. The physician is recalled. He observes the temperature of the patient and finds it either normal or subnormal, or possibly, if more than six or eight hours after the beginning of the attack, it may reach to 99 or 100. The pulse is rapid, from 110 to 130. The abdomen is tense, but not distended. So soon as the violent tenesmus has passed, the abdominal wall may be palpated, and now in the right side there is to be felt a long, soft, somewhat sausage-shaped tumor. Pressure upon this tumor gives rise to violent contractions of the abdominal and perineal muscles, and to evident tenesmus. During these paroxysms there may occur sudden urination.

After the first twelve hours the abdomen begins to increase in size, the intestines become distended with

gas, the temperature begins to rise, the child's thighs are held flexed upon the abdomen. The crying is less frequent and not so violent. Respiration becomes superficial and rapid. The pulse is quick, from 120 to 160. The face has acquired the dreadful Hippocratic expression, and dark rings appear under the eyes. The discharge of blood from the rectum is continuous and excessive, and death occurs in from 24 to 48 hours after the beginning of the attack.

If we confine our attention entirely to cases of intussusception occurring in children, which make a distinct clinical group, the symptomatology is very pronounced and highly colored. As Boas says, "Of all forms of intestinal obstruction, intussusception presents the most favorable conditions for early diagnosis." The most prominent symptom, and the one first to attract attention, is the onset of severe colicky pain which in the suckling usually appears while the child is at the breast, and in the slightly older child while he is eating. This pain is agonizing, continuous, and in children frequently produces convulsions or collapse, which latter may, in some cases, be so severe as to render death imminent. The pain is attended by such violent peristaltic movement of the bowels that the abdominal walls are raised into distinguishable, shifting ridges. After the pain has endured for an hour or more the child becomes exhausted and may even fall asleep in a collapse and cold sweat. Then a new paroxysm is initiated, accompanied by more violent peristalsis and the passage of a bloody stool. The anal sphincters are paralyzed, and the mucous membrane of the rectum protrudes. This

paralysis of the sphincters is said to be earlier and more complete in invaginations involving the cecum or colon. Pain is present in practically every case.

Vomiting is a very constant, pronounced, and early symptom. In almost all cases fecal vomiting occurs after a few hours of suffering. With the initiation of severe pain the contents of the stomach are usually ejected, and this first eructation is followed by repeated and painful attempts at vomiting with every renewed peristalsis of the bowels. It is probable that the vomiting is earlier and more constant as the obstruction is the more complete.

The character of the stool is a very significant, and to the mother a very alarming, symptom. After the first evacuation, which follows hard upon the initiation of pain, the stool becomes first watery in consistency, and slightly tinged with blood, and later bloody, with only slight traces of fecal matter. This relative absence of fecal matter is a symptom of great diagnostic value. In from 12 to 24 hours succeeding the first attack shreds of mucous membrane, and even long pieces of the necrotic intussusceptum may be passed in the stool, but such an issue should never be awaited. In less than 20% of cases of acute intussusception the bloody stools are absent, and then only in the less severe or subacute cases.

Tympanites, distention of the abdomen, or meteorism, is a rather late symptom of the disease. It is early in case the invagination produces a complete obstruction of the bowel. It usually indicates the onset of an infectious peritonitis, and the end of a hopeful period for surgical interference.

The most positive diagnostic symptom is the appearance of tumor. This is usually to be felt in the right inguinal region as a long, soft, and exquisitely tender mass. In order to recognize the tumor with certainty it is sometimes necessary to anesthetize the child. It varies in bulk from the size of a hen's egg to an enormous mass half filling the abdomen. In the latter case it is often mistaken for a fecal impaction. The tumor is somewhat movable, especially its cephalic or left end. It is easily indented with the finger but does not long retain such indentation. It frequently pulsates, and when very extensive, or when it is in the descending colon, it occasionally protrudes through the anus.

Up to the end of the first twelve, or in less acute cases the first twenty-four, hours, the temperature is normal or subnormal, but with the appearance of the bloody stools one of two possible fluctuations in the temperature may be noticed. In the one case hemorrhage may be so great as to reduce the temperature considerably below the normal, and in the other event infection may come on so rapidly as to elevate the temperature to a considerable height. After the first twelve or twenty-four hours of the disease there is certain to appear a peritonitis with tympanites, and a coincident rise of temperature to 101 or even so high as 105.

The heart's action is greatly accelerated from the very first. With the convulsion or collapse which follows the initial agonizing pain the pulse rate is markedly quickened, and in direct proportion to the severity of the collapse it is weak or imperceptible at the wrist.

The face rapidly acquires the Hippocratic look. I know of no observations on the condition of the blood and urine in the course of an invagination in a child.

The diagnosis of intussusception in acute and hyperacute cases ought to be made with ease, and during the first two or three hours of the disease. The symptoms are more sudden, more severe, and more pathognomonic than those of volvulus and incarcerated hernia, for which conditions it may reasonably be mistaken, and they are not very similar to those of appendicitis, for which they have occasionally been misinterpreted. Volvulus is an extremely rare condition, especially in children. Its symptoms are similar to those of intussusception, except for the absence of the bloody stools, and of the long, sausage-shaped tumor. There is, however, the presence of the round and rapidly increasing tumor dependent in the cephalic part of the abdominal cavity. In incarcerated hernia the hernia is usually present, or there is the history of a hernia which has been reduced. The bloody stools are absent, and an immovable tumor can usually be found in the region of the internal abdominal ring. In appendicitis there may be present the characteristic tumor, but the bloody stools are absent, and the temperature and leucocytosis are out of all comparison with the same features as they exist in intussusception, except in the very late stage of this disease. In appendicitis the appearance of tumor is usually preceeded by tympany and partial obstruction of the bowels, and by a period in which there was fever, vomiting, and intermittent abdominal pain.

The prognosis in intussusception in the very young is so unfavorable that it may be declared an absolutely fatal disease.

In 1897 Gibson tabulated with great care all the cases of intussusception, 239 in number, which he found recorded in medical literature. In this entire list there is no record of recovery from irreducible intussusception in a patient under seven years of age, and there are only nine cases of recoveries in older patients. At the very best not more than ten or fifteen per cent of these children recover when they present symptoms which could reasonably establish the diagnosis. In these rare cases the gut seems to return to its normal condition either as the result of the administration of an anesthetic seconded by a large enema and manipulation, or spontaneously after relieving the pain with large doses of morphine. In all these reported recoveries the observations have been so slovenly, and the diagnosis so uncertain, that one is justified in holding them in doubtful esteem. If the patient is observed during the first few hours of the disease, and if the diagnosis is confirmed by the presence of the tumor and the bloody discharges, an immediate laparotomy is to be recommended. If the child is observed after the onset of peritonitis, certainly no physician even would believe that a reduction of the intussusception were possible, or that an attempt at the insufflation of air or the injection of water could be other than a menace to the life of the patient. Every hour that passes after the first few necessary for diagnosis only adds to the unfitness of the patient to withstand the traumatism of opera-

tion, and the probability that the resection of the tumor will present insurmountable difficulties.

The fitness of a surgeon to operate upon a case of intussusception depends upon his ability to perform a resection of the bowel under trying and somewhat unfavorable conditions. Since the thought of delay is not to be entertained even the surgeon who is not possessed of the highest skill must hold himself in readiness to meet this trying emergency, and this he must not refuse to do because he fears to encounter unusual difficulties, perhaps a surgical impossibility, with later the onus of a fatal termination. A strangulated hernia, an intussusception, and obstruction of the bowels from appendicitis, demand surgical interference every time they are encountered, and that without delay or consultation.

The operation is performed with the best surgical surroundings which can be improvised. The abdomen is opened widely either in the median line, or when the tumor is in the right inguinal region by a long incision on the outer border of the right rectus. As soon as the tumor is approached, and the general peritoneal cavity is walled off by protecting compresses, a very cautious attempt should be made to reduce the invaginated gut. This is usually impossible of accomplishment, and not devoid of danger. The intussuscipiens is grasped in the hand, and an assistant makes careful pressure upon the included end of the intussusceptum, while the operator makes traction upon its oral end and its mesentery. Occasionally the spud, or dull dissector, may be used in breaking up any trifling adhesions which may have

united the peritoneal surfaces of the invagination. If this gentle manipulation is followed by the reduction of the invagination, the operator has yet to decide whether or not the gut has undergone such degeneration as to make resection imperative. If he decide to leave the gut intact, he must ask himself how he can best prevent a recurrence of the invagination, and how cover the denuded gut with peritoneum. Probably the best method and the safest is to surround the abraded gut and mesentery with an omental wrapper. This procedure should be remembered, however, as a possible cause of subsequent trouble; an omental band, a hernia behind it, or a volvulus and obstruction of the bowel. The gut may be resected if too much destroyed to be safely left behind, and it must be resected if reduction is impossible.

The method of making the resection must depend upon the skill and experience of the operator. With no special surgical instruments the method of Connell can readily be carried out. The invaginated portion of the ileum is clamped with a pair of artery forceps placed transversly to the long axis of the gut, and extending only so far as to the beginning of the mesentery. The point of the forceps should reach the mesentery a short distance from one of the recognizable branches of the mesenteric artery, for upon the preservation of this blood supply may depend the success of the operation. The intussuscipiens is then lifted up into the wound and with a scalpel an incision is made in the distended gut, at a point as near the oral end of the intussuscipiens as the branch of the mesenteric artery above selected will permit, and

is carried around the gut to meet a second artery forceps which has been thrust through the mesentery at a point opposite the beginning of the incision. This second forceps is clasped upon the mesentery in the direction of the one first applied, and the intussusceptum is drawn out of the inclosing intussuscipiens and cut away from its mesentery and from the gut which is clamped by the forceps first placed. Great care must be taken to separate the gut from its mesentery so as to leave the mesentery as long as possible, and also to cut away all of the mesentery that has become necrotic or dangerously thrombosed. During the manipulation incident to the resection, the adjoining intestine is protected by thin gauze laparotomy sponges, walling off the rest of the peritoneal cavity.

After removal of the tumor the suture is performed in the manner directed by Connell. The greatest care must be taken to securely close the mesenteric wound after complete arrest of all hemorrhage. The crucial point in the entire procedure, however, consists in securing to the cut edge of the mesentery, and to the coaptated portions of gut, an adequate blood supply. If after the resection is completed, and the suture placed, the coaptated gut is not well supplied with blood, no favorable issue can be expected.

Occasionally the invagination is complicated by an appendicitis, or by the inclusion of a portion of the omentum. The appendix should be removed with the head of the colon, or the appendicectomy may be performed as a separate operation. If the omentum is involved it should be ligated and its cut end rolled in

so as to be covered with peritoneum, and fastened in this position with a row of catgut stitches. Personally I cannot recommend any form of extrusion of the tumor by anastomosis, or the production of an artificial anus, and certainly every one must agree that no time should be wasted in dangerous and fruitless attempts at insufflation of air, or of hydrogen gas, or the injection of water to reduce the intussusception.

Allingham (London Lancet, August 24, 1901), reports two successful operations for intussusception. In both the appendix was removed, and in neither had any attempt at insufflation been practiced. The first case was in a healthy boy, fifteen months old, who had been seized by acute abdominal pain, followed by diarrhea and vomiting. The stools presented the characteristic bloody mucus. Nineteen hours after the onset of the disease the abdomen was slightly distended and tender, and a firm mass could be felt in the umbilical region. On opening the abdomen an ileocecal intussusception nearly a foot in length was discovered. After its reduction, and the removal of the appendix, the wound was closed and recovery was complete in two weeks. The second case was in a child with a similar history. The operation was performed two days after the onset of symptoms, and revealed an ileocecal intussusception involving the whole of the colon down as far as the sigmoid portion. The bowel was black and slightly edematous, but its peritoneum was still shining. The invagination was reduced, appendicectomy performed, and recovery was established by the eleventh day.

Ouvry (Gaz. hebd. de Med. et de Chir., June 20, 1901) reports a case of intussusception in which the gut presented at the anus. A catheter was introduced into its lumen and passed upwards until a quantity of fetid yellow liquid and much gas was discharged. The bowel was washed out several times with a normal salt solution and the catheter left in place. Recovery followed.

Sells (London Lancet, August 31, 1901) reports a case of subacute intussusception in a child four months of age, in which eighteen inches of the ileum had passed the ileocecal valve. Laparotomy was performed on the third day, when the child showed very little collapse. Though quite edematous the invagination was reduced and the recovery was complete.

INVAGINATION OR INTUSSUSCEPTION

Intussusception.
- Physiologic.
- Pathologic.
  - Enteric invagination.
  - Colic invagination.
  - Ileocecal invagination.

Etiology.
- Age, early childhood.
- Sex, males 72%, females 28%.
- Ending of ileac peristalsis and beginning of cecal peristalsis.
- Neoplasms of intestinal wall, benign and malignant.
- Polypi, carcinoma and sarcoma.
- Foreign bodies.
- Ulcers.
- Strictures.
- Chronic enteritis and dysentery with atony; peristalsis.
- Trauma and violent agitation of the body.
- Weak and emaciated individuals.
- Hereditary, similar to hernia.
- Typhoid fever.

- **Symptoms.**
  - Abdominal pain.
  - Nausea and vomiting.
  - Tumor.
  - Hemorrhagic evacuations.
  - Meteorism.
  - Tenesmus.
  - Onset sudden, may be in perfect health.
  - Diarrhea stools, mucus, blood and ingesta.
  - Pulse rapid and compressible.
  - Phenomena of collapse.
  - Temperature below normal or slightly raised.
  - Peritonitis.
    - Pulse very rapid.
    - Temperature elevated.
    - Rigidity of abdominal muscles.
    - Anxious expression of face.
    - Leucocytosis high.
    - Whole abdomen tender.
    - Marked tympanitis.
    - Vomiting stercoraceous.
    - Coma.
    - Death.
- **Cause of death.**
  - Shock and collapse.
  - Result of intestinal occlusion.
  - Gangrene.
  - Peritonitis.
  - Thrombosis of mesenteric veins.
- **Course.**
  - Acute.
    - Death.
    - Recovery.
    - Chronic form.
  - Chronic.
    - Chroncic enterostenosis.
    - Scar found at postmortem.
    - Acute symptoms with recovery or death.

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CHAPTER X

PERFORATING TYPHOID ULCER

Introduction; statistics; relative frequency and danger of perforation; size, number, and location of openings; symptoms and diagnosis; treatment; methods of performing the operation; statistics of operation; illustrative cases; bibliography.

In our present state of irresponsible civilization typhoid fever is an ever-present evil; how much so may in a measure be estimated by the fact that in the United States, during the census year 1890, 27,058 persons—15,078 males and 11,980 females—died of this disease. This is at the rate of 46.27 deaths annually to the 100,000 of living population. In 1900 there were 35,379 deaths—18,881 males and 16,498 females—or 35.4 to the 1,000 deaths from all causes. In other countries the death rate from typhoid is rarely so high. In England and Wales it averaged about 20.5, in Ireland 16.5, in Scotland 24.7, in Sweden 25.9, in Norway 10.7, in Prussia 38.3, and in Austria 72.2 to the 100,000 of living population for the years between 1880 and 1890.

In the various states of this country the death rate from typhoid varies greatly, doubtless due to the different customs, habits, and economic conditions of the people, and to the relative distribution of the inhabitants in the rural districts and in cities. As

factors contributing to the mortality from typhoid should also be considered the average age of the population, the prevalence of other life-destroying diseases, and the character and equipment of the local medical profession. The accompanying map shows the death rate from typhoid in the several grand divisions of the United States, per 1,000 deaths from all causes, as shown in the census of 1890.

The well-known variation in the death rate of typhoid fever for the several months of the year is readily recalled by consulting any census report on the vital statistics of the United States. It will be observed that the mortality is highest during the months of August, September, and October. Again, the mortality is much higher among males than among females. The deaths are very much concentrated around the periods of early manhood and womanhood. The fact that strong young adults suffer more severely of this disease suggests an acquired immunity in the aged.

The death rate of typhoid fever varies in different epidemics, in different age and sex groups, in different methods of treatment, and under different social and occupational conditions, anywhere from 6% to 17% of all persons attacked by the disease. In selecting 10% as a general average we shall not be far from the actual condition.

In a collection of 580 deaths from typhoid, studied at Hamburg and Leipsic, death resulted from intestinal hemorrhage in 7.3%, from the severity of the infection in 46.9%, and from perforation in 16.1%.

From these statistics it becomes strikingly evident

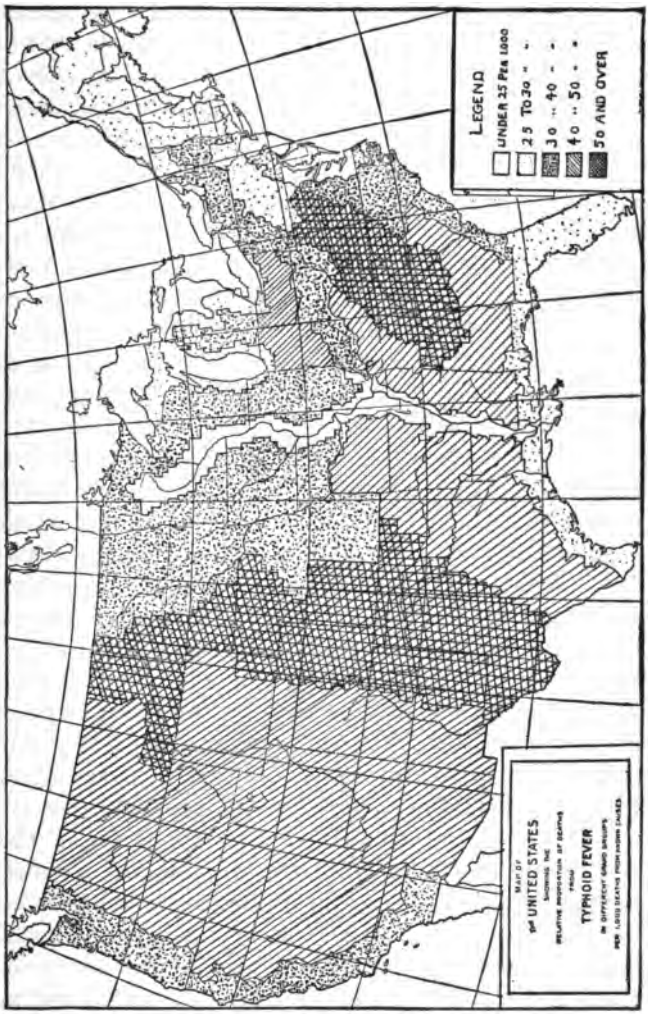
LEGEND
UNDER 25 PER 1000
25 TO 30 " "
30 " 40 " "
40 " 50 " "
50 AND OVER
TYPHOID FEVER

Fig. 39.

that perforation is so real a danger that in the care of any case of typhoid the physician should bear it in mind as a possibility, and inaugurate such treatment as will diminish the chances of its appearance; keep such records and make such examinations as will insure its recognition at the earliest possible moment; and have ready prompt and efficient surgical relief. In anticipation of some serious accident every case of typhoid should be the object of the most conscientious study. The treatment should be as scrupulously conducted, and the records of treatment as carefully kept as if a legal investigation might at any moment be instituted. The present-day physician cannot be regarded as giving to his patient the best service unless he keep a full and complete record of the temperature, pulse, urine analyses, blood examinations, and Widal tests; of the general physical examination, of the baths and their effect, of the food given, and the character of the stools. The text-books of medicine give full particulars as to treatment, and to them the student is referred for such details, but in these pages it is more fitting that his attention should be directed to the importance of accurate diagnosis, and the watchful preparation for an accident that occurs upon an average in from two to five of each one hundred cases of typhoid fever.

Intestinal perforation is to be looked for at the end of the second week of the disease, and even so late as two weeks after the temperature has become normal; at any time in ambulatory cases; in cases in which diarrhea has been a prominent symptom; in cases in which a hyperleucocytosis is present; and in

patients who have surreptitiously, or in some unguarded manner, ingested large quantities of solid food. It is much more common in ambulatory or light cases than in severe and toxic cases, and it is almost three times as frequent in men as in women. Cases in which hemorrhage is a feature are rather more prone to perforation than others. In a few instances there has been a warning peritonitis, probably due to a thinning of the bowel wall.

The usual site for the perforation is the region of the ileocecal valve, but it may be found as far distant from this location as 18 or 20 inches. Usually the perforation is single; occasionally multiple openings exist; as many as 10, 15, and even 25 perforations having been observed at the necropsy. Adhesions rarely form about an impending perforation, and this form of protection which is offered the general peritoneal cavity in cases of ulcer of the stomach, of perforating appendicitis, and of perforation about a gall stone, is not to be expected in typhoid. General peritonitis is the invariable result of typhoid perforations.

The perforations are usually quite small—a mere point upon the surface of the gut—but occasionally they are relatively large, due to the corresponding necrosis of the intestinal peritoneum overlying the ulcer. In one patient, twelve hours after the appearance of symptoms of perforation, there was found a defect in the gut half an inch long, and at least a quarter of an inch wide. The necrotic mass of mucous membrane and muscular elements sometimes persists under the peritoneal defect, and acts as a

valve. In other instances it will have passed off prior to the occurrence of perforation. In a few cases the perforation has been found in the appendix, the head of the cecum, and in a Meckel's diverticulum.

The diagnosis of perforation depends upon a complete history of the case, the repeated examination of the patient, and the prompt recognition of the significance of a sudden, intense abdominal pain, with collapse. The most characteristic objective symptom is the sudden appearance of a leucocytosis in a typhoid patient who is otherwise progressing favorably. This leucocytosis probably stands for the invasion of the ulcers by pus microbes, or by the colon bacillus. It should serve to warn the physician of a threatened perforation, or of the localization of infection elsewhere in the body. When this symptom presents itself, and careful examination reveals no abscesses either in the skin or in the lymph glands of the groin or axilla; no pus in the urine, or any infection in the sinuses of the head or face; no bronchitis, no pleuritis—then the subjective symptoms of a perforation should immediately be sought. Pain is the most conspicuous of these symptoms. It is usually sudden, severe, and prostrating, and appears quite definitely located in the lower part of the abdomen. Very often it comes on at midnight, and the nurse gives an enema with some temporary relief; but in a few hours the pain comes on again, with tenderness in a fixed part and tympanites. The exhibition of this pain may be masked by opium or by the stupefaction of the patient due to the disease itself. The tenderness in a fixed point is accompanied by abdominal rigidity

and thoracic breathing. It must not be forgotten that pain simulating that of perforation often appears in the abdomen, and may lead to error in diagnosis, especially in the less severe cases of typhoid, and in physicians and nurses who are able to interpret symptoms and are on the watch for them.

A case in which this element of auto-suggestion was a factor is that of a medical student who suffered of typhoid during the summer of 1902. He presented the typical symptoms of the disease; the Widal reaction appeared a trifle tardily, but the patient's mind was active and unclouded. At the end of the fourth week, about midnight, he was seized with a dreadful abdominal pain, located in the ileocecal region. It was so severe and so prostrating in effect that he at once made a diagnosis of perforation, and since he had either some fear, or some prejudice, against operative procedure in such cases, he refrained from notifying his nurse of the suspected accident, and mentally bade himself farewell. He fell into a profuse perspiration, and the pain was displaced by sleep. In the morning when he awoke he could hardly believe himself alive, so vivid had been his impression. From this time on his recovery was rapid and uneventful.

The leucocytosis not infrequently appears from twelve to twenty-four hours before the perforation takes place. Abdominal pain is the warning note. The temperature and pulse should then be observed at fifteen-minute intervals or oftener, and if during the hour subsequent to the onset of pain the temperature suddenly rises, or as suddenly falls, if the pulse

becomes rapid, if vomiting come on, and the patient is in collapse, there is then every reason to believe that perforation has occurred. In this event a higher degree of leucocytosis appears, and a hemorrhage may occur at the same time which either discharges through the bowel or escapes into the general peritoneal cavity.

If the perforation allows of the discharge of gas into the peritoneal cavity, the normal liver dullness quickly disappears. This event requires hours for its consummation, and the discharge of a considerable quantity of gas. During the first twelve hours tympanites and abdominal distress come on and the temperature and pulse begin to rise again. All of these symptoms, save the disappearance of the liver dullness, may be present without actual perforation over the site of the ulcer. By the end of twenty-four hours there is free fluid in the peritoneal cavity.

There are two errors in the diagnosis of typhoid perforation into which the physician is likely to fall. A patient may present, during a period of an hour or so, most of the symptoms of perforation, and yet the symptoms may disappear and the patient recover without having had more than a threatened perforation. In Keen's statistics two cases are reported as operated upon, and no perforation discovered. This error is a very pardonable one, because the actual opening of the abdominal cavity, in a typhoid patient under local anesthesia, is not a matter of very serious consequence. The second error is in mistaking for a perforation some other form of peritonitis. Appendicitis is not a very rare complication of typhoid

fever, and perforation or gangrene of the appendix, of a non-typhoid character, cannot be certainly differentiated from a perforation through a typhoid ulcer. Late in the course of the disease the suppurating mesenteric lymph glands have given rise to similar symptoms. In either of these cases the laparotomy is indicated, although the chances of recovery are perhaps less in rupture of a mesenteric lymph gland than in a peritonitis arising from an appendix, or a typhoid ulcer.

It seems quite possible that the observation of the blood pressure will be a factor of great value in the diagnosis of typhoid perforation, especially in hospital practice. Crile (Jour. Am. Med. Assn., May 9, 1903) finds that the highest systolic pressure in uncomplicated cases of typhoid, measured by the Riva Rocci sphygmomanometer, falls during the course of the disease from an average of 115, and a maximum of 138 in the first week, to 106 in the second, 102 in the third, 96 in the fourth, and 98 millimeters of mercury in the fifth week. There is a sudden and rapid rise of pressure during the first hour or two after the onset of peritonitis from perforation. In one instance the pressure rose to 208, and in another to 156, with an average record of 166. In one case of Crile's the blood pressure rose from 116 to 190 in four hours. In another, a lad of twelve years, the blood pressure was 105 on admission, and the patient presented all the symptoms of perforation. Immediate operation was performed, the blood pressure fell to 80 millimeters, and the symptoms disappeared. On the eighth day following operation infection passed

through the thin wall of another ulcer, causing a second attack of peritonitis, and the blood pressure responded with a sudden rise to 110. In a third case the pressure rose from 116 to 165 in two hours, while in a fourth case, presenting all the symptoms of a general peritonitis, the blood pressure was 165; and in a fifth, a case of typical perforation, a pressure of 208 was registered.

The diagnosis of a perforating typhoid ulcer is essentially a relative one. The pain, the collapse, the rising or falling temperature, the rising pulse, and the rapidly increasing leucocytosis, may all be present without actual perforation. The collapse, the rapid pulse, and even the pain may be present in hemorrhage. The entire picture of the disease must be considered. The patient is in the beginning of the third week of the disease. He has had, during the previous few days, an increasing leucocytosis. He is suddenly seized with excruciating abdominal pain, followed by collapse, rigidity of the abdominal muscles, general abdominal tenderness, vomiting, a falling temperature, a rapid and thready pulse, a sweat, and if sufficiently conscious, a great mental distress and anxiety, wholly inconsistent with the general picture of typhoid. The pain comes on with great suddenness, and is persistent in character. The tenderness appears gradually, and is followed by tympanites and distension. The persistence of these symptoms during three or four hours constitutes a diagnosis sufficiently absolute to warrant a laparotomy.

When the diagnosis of perforation has been made as positive as possible, and two or three hours have

been allowed to elapse to confirm or deny the permanency of the symptoms, it becomes necessary to consider the treatment to be instituted. Under no circumstances should morphine or other anodynes be given, which but mask the symptoms and obscure the diagnosis. Pain is so important and conspicuous a symptom that it should not be eliminated by the administration of opium, however much the patient or his friends may clamor for it, and however much the physician may be tempted to lull the fears of the family by quieting the patient's distress.

If the attending physician is himself a skilled operator he should certainly prepare for a laparotomy, and the surgical treatment of the perforation. It were well, in a procedure so recently established, and one so grave in its results, that the attendant and operator fortify himself with the best consultation at his immediate command. If he does not consider himself competent, he should secure the best operator whose services can be commanded at from two to three hour's notice.

The operation should immediately follow the diagnosis. Delays are excusable only to clear up the diagnosis in doubtful cases. Keen recommends that the operation be done after the shock shall have subsided, and definitely about the end of the twelfth hour following perforation. This would seem in most cases to be too long a delay, and if our experiences in the treatment of perforating gunshot wounds, and of appendicitis and gall-bladder perforations may be allowed to weigh in this consideration, the call must be for earlier operation.

The patient is certain to have more or less a fatty heart, and this, in conjunction with his generally diminished vitality, rather speaks against the use of a general anesthetic except when the patient, either through delirium or perversity, resists the procedure. The preparation of the patient should be conducted with the greatest care in order that dissemination of the infection throughout the general peritoneal cavity may not be encouraged by the necessary manipulation.

The tissues should be anesthetized with the most dilute Schleich solution, and the primary incision made, preferably along the outer border of the right rectus. Fortunately the abdominal walls will be found greatly thinned through the absorption of the body fat during the course of the disease. When the abdominal cavity is opened the presence of gas, or the appearance of serum containing the intestinal contents or clots of blood, will at once confirm the diagnosis. Palpation of the intestine is not painful, and the search for the perforation is rendered easier by the fact that the ulcer is surrounded by a turgid area of gut with a few shreds of attached lymph.

There are two methods of treatment suggested. The one is the obliteration of the perforation by means of suture, and the other is the attachment of the open gut to the peritoneal margin of the abdominal wound. In the course of any operative procedure the greatest care not to spread the infection throughout the peritoneal cavity must be exercised. As we have already seen the protective adhesive peritonitis is less frequently observed in perforating typhoid

ulcer than in other forms of infection. The operator must not expect to find a circumscribed abscess, nor must he expect to find the perforated intestine adherent to omentum, or to adjoining viscera. The ileocecal valve should at once be brought up into the wound, and after protecting with gauze the adjoining intestines, search the last eight or ten inches of the small gut for the existent or threatened perforation. This can be done deliberately, and almost painlessly, if proper consideration for the patient is exercised. The protective tamponade of the abdominal cavity should be made with small strips of gauze lightly filled with iodoform, in order, should necessity require, they may be left behind as a part of the drainage. Renewals of the tamponade during operation are fraught with the greatest danger to the patient. If the perforation is small it may be buried by means of a purse-string suture, reinforced by a row of interrupted Lembert stitches. If the perforation is extensive a partial or complete resection of the intestine may be necessary. The operation should be conducted as rapidly and as painlessly as possible, and the sutured portions of the gut should be brought into immediate contact with the tampon.

If, as is less frequently the case, the patient is a woman, the introduction of a vaginal through-and-through drainage would be a desirable addition to the procedure. This measure could hardly be attempted without a general anesthetic.

A second method of treating the perforation is that recommended by Escher of Trieste. The abdomen is opened under Schleich solution at the first appear-

ance of symptoms of perforation. The point of perforation being found the gut is brought into contact with the abdominal opening, and stitched to the peritoneal walls of the wound by one or more catgut stitches. The surrounding intestines are protected by an antiseptic tampon. This method is one which can be practiced by the inexperienced operator, and the drainage which it affords the gut, and the surrounding peritoneum, is most favorable to recovery, although from a surgical standpoint it is far from being the ideal procedure.

Blake has treated perforating typhoid ulcer in a most daring and radical manner. The opening of the abdomen and closure of the perforation is accomplished in the usual way. The abdominal cavity is thoroughly and carefully flushed out with a large quantity of hot, sterile normal salt solution, and the abdominal wound is closed. He has had an almost unbroken series of recoveries by this method, yet few operators have had the hardihood to follow him except when the minimum amount of time has elapsed between the perforation and the operation. It is certainly the ideal surgical treatment barring the danger of leaving peritonitis behind.

The physician will often be tempted to wait with a view to making a differential diagnosis between a perforation, a hemorrhage, and a pain or collapse from some other unknown cause. The diagnosis is so relative in any case, and so doubtful in many cases, that laparotomy may be performed and no perforation be found without criticism falling upon the physician or surgeon. The experience which the average phy-

sician may reasonably be expected to have with this terrible accident is so small that skill in diagnosis must be acquired from the careful study of cases reported by other observers. The results of the surgical treatment of perforation, the infrequency of its performance, and the relatively high death rate which still attends it, has encouraged, or at least permitted, the general busy practitioner to adhere to the old expectant treatment of this condition. Again, the community has long been educated to the belief that typhoid fever is a dangerous and excessively fatal disease, and has not learned to demand of the profession a more radical and effective method of treatment.

The result of operation upon perforating typhoid ulcer must be regarded as a clear gain whenever a life is saved. The prognosis without operation and drainage is absolutely unfavorable. Scarcely 1% is claimed for medical treatment, and then only by the formation of an abscess which must subsequently be opened. The results of the surgical method show a gradually increasing percentage of recoveries. In 1898 Westcott collected the reports of 83 cases, covering a period of ten years, with 19.2% of recoveries. In Osler's clinic 12 cases have been operated on during the past five years, with 41.6% of recoveries.

Armstrong reports that 932 cases of typhoid fever were treated during the six years ending 1902 in the Montreal General Hospital. Perforation occurred in 34 cases, or 3.33%. The accident was recognized in all but one case of a most malignant and toxic character. In 33 instances operations were per-

formed; recovery followed in five of these. One patient died of toxemia five days after the operation. If this case be included, the recoveries amounted to 18.18%. Three of the recoveries were in males and three in females.

The following cases, reported by Dr. Weller Van Hook, are introduced not only for their clinical value, but as well for their historic interest. Case I. is the record of the first successful operation for perforating typhoid ulcer performed in the United States, and indeed, though the latter fact is disputed, in the world. The other two cases belong also to the early history of this procedure.

Typhoid fever with relapse during the fifth week; sudden pain with collapse one week later; diagnosis of perforation, with peritonitis; operation, revealing single perforation near the ileocecal valve; recovery.

Miss S., 31 years of age, height 5 feet 6 inches, weight 140 pounds, was first seen by Dr. John Fisher, June 24, 1891. Hitherto in perfect health, she had been ailing with headache and chilly sensations for a week past. Her temperature at the time of the first visit was 103, and her pulse 112, and her tongue dry. A diagnosis of typhoid fever was made. Small doses of antipyrin relieved the headache, and slightly reduced the temperature; she was kept on a liquid diet, and at the end of the third week was so far recovered as to begin attending to light domestic duties. After being apparently free from fever for fourteen days (the thermometer was not used during this period), she suffered an unmistakable chill on July 17. On the following day she presented a temperature of 104, a pulse of 120, severe headache, and much prostration. Dr. Fisher diagnosticated a relapse of typhoid fever, and instituted the same treatment as before. On the seventh day of the supposed relapse, the bowels not having

moved for thirty-six hours, an enema of warm water was given. This, in a few hours, was followed by two passages, and by a third at 4 A. M. of the eighth day. At 5 o'clock she was suddenly seized with great pain in the ileocecal region, followed by a cold sweat, coldness of the extremities, and an excessively pinched and anxious expression of countenance. Dr. Fisher saw the patient at 7 o'clock, and found a temperature of 105.5, with a quick, wiry pulse of 126. Soon afterwards the pain almost ceased without the administration of anodynes. Dr. Fisher recognized the symptoms as those of intestinal perforation, and at 9 o'clock, on seeing the patient with Dr. Fisher, I confirmed his diagnosis by the following points:

First. The history of the case pointed indubitably to the existence of typhoid fever.

Second. The mechanical explanation of a perforation was supplied by the fact that active peristalsis had been excited by the enema.

Third. The symptoms of anxiety, pain, and shock were typical.

Fourth. The objective symptoms already noted were supplemented at that time (four hours after the accident) by a rising temperature (106), and an increasing pulse rate (132), plus the typical signs of peritonitis, viz., tympanites, tension of the abdominal muscles, and tenderness upon pressure over the ileocecal region.

On account of the lack of the friend's consent, the operation could not be begun before 2:40 P. M., when I opened the abdomen. The incision, in the median line below the umbilicus, opened the peritoneum through an extent of about 2½ inches, which afforded ample room. No gas escaped (the liver-dullness had not been altered), but more than a pint of fluid feces and exudate, mixed with flocculi of lymph, was removed. On gently pulling out coils of small intestine in the direction of the ileocecal valve, numerous ulcers — one or two of them almost perforations — were seen. Flocculi of lymph over the surface of the inflamed bowels indicated the points where the peritonitis was oldest and most violent. That the peritonitis was general was indicated by the several facts that all the coils seen were injected and dull-looking,

and that the fecal matter was freely circulating in the peritoneal sac. When two or three coils had been drawn up and examined, the opening was found. It was irregularly circular, and about two millimeters in diameter. While the coil was held up (it being the only part of the intestine now exposed) the feces were carefully sponged off with sterilized gauze, and the opening closed with three longitudinal rows of interrupted Lembert sutures. The gut walls were so thick, and so brittle from edema, that three rows were thought necessary to insure strength. I did not look for other perforations in this case because it seemed to me that the woman had a remote chance of recovery if she could be quickly put to bed. Consequently not more than 2½ feet of the intestine altogether were exposed. The abdominal sac was now thoroughly and carefully washed out with nearly half a washboilerful of hot sterilized water. The omentum was carefully drawn over the injured coil of intestine, and stitched to the mesentery. A large drainage tube was passed to Douglas' cul-de-sac, and the remainder of the abdominal wound closed. The patient was much exhausted at the close of the operation, but was not in collapse, although the pulse was small and rapid, and the temperature high. On the following morning, at 9 A. M., the abdomen was enormously distended, and everywhere tender, and the patient looked moribund. Enemas of an ounce each of magnesium sulphate, glycerin, and water had been given three times, beginning two hours after the operation, once with a double dose, without effect. At 11 o'clock, however, the bowels began to move, and she had ten or twelve watery passages, after which she began to improve. The tympanites diminished, the pulse improved, and the amount of fluid aspirated from the tube was much diminished. The temperature remained at 103 for four or five days, when the symptoms of peritonitis began to disappear. The tube being withdrawn, the wound healed, and the symptoms of typhoid, running a normal course by a typical defervescence, ended in two and one-half weeks. The patient is now enjoying perfect health.

Typhoid fever with perforation occasioned by exercise; operation; death; necropsy revealing multiple perforations with adhesions.

A. S., Bohemian, 29 years of age, entered Cook County Hospital June 12, 1891. She was stupid and dull, presenting all the classic symptoms of typhoid fever. No previous history could be obtained. The course of the disease was typical and regular until the morning of June 28, when the patient got up and walked unobserved to the bath-room. She was taken back to her bed, and immediately seemed to be in great pain. When seen by the house physician, the tense, rigid, distended abdomen, with loss of liver-dullness, pointed to perforation. Her general condition was that of collapse, the pulse being rapid and thready, and the skin cold and clammy. On her being transferred to the surgical department I concurred in the diagnosis, and opened the abdomen seven hours after perforation had occurred. The peritoneal sac was found filled with thin, liquid, feculent matter. The patient becoming rapidly worse, despite stimulation, the operation was not completed. The patient died a few minutes later. At the necropsy an oval perforation was found in the ileum, eighteen inches above the caput coli. The visceral peritoneum around the perforation was adherent for three-fourths of its circumference, the remaining portion having probably been loosened by the traction occasioned in walking. A second ulcer was found opening into a small abscess cavity within the peritoneum. Adhesions shut it off completely from the general serous sac.

Perforation following typhoid; operation; death.

John Connell, 35 years of age, walked into the Cook County Hospital October 30, at 5 P. M. His temperature was 102; pulse 120, being small, soft, and irregular. The patient looked pale and haggard; his eyes were sunken; his abdomen was moderately distended, rigid, and extremely sensitive to pressure all over; his mind was dull. A diagnosis of probable typhoid fever was made. Fourteen hours later it was found that the liver-dullness was absent, and as the patient was in a collapse a diagnosis of per-

foration was made. The patient being transferred to my service, the abdomen was opened, and a perforating ulcer found about twelve inches above the ileocecal valve. The opening was closed by a double row of Lembert stitches. The abdominal cavity was found filled with fluid feces and exudate. The peritoneal sac having been washed out and drained, the patient was put to bed in fair condition, and lived fourteen hours. The necropsy showed general peritonitis. The perforation had been completely closed.

Without a perforating ulcer a peritonitis may appear in the course of a typhoid, due to the migration of the organisms through the wall of the intestine. Dr. J. L. Gates, American Medicine, May 2, 1903, has brought together the experience of the whole medical profession on this subject. The manner in which the peritonitis is set up is not very significant. Sometimes it is a ruptured infarct; sometimes a broken down lymph gland; but in every case the symptoms and findings are those of peritonitis in the neighborhood of a typhoid ulcer, but with gas and fecal matter absent. The infection is sometimes the typhoid bacillus alone, but in most of the others there is a mixed infection. Gates gives a very complete bibliography of the subject.

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CHAPTER XI

CARCINOMA OF THE INTESTINAL TRACT

Statistics of carcinoma of the intestinal tract; location; clinical picture of the disease; symptoms and findings; indications for operation; the three surgical procedures; carcinoma in the appendix; bibliography.

The distribution of carcinoma in the intestinal tract has the greatest diagnostic and surgical interest. In the abdomen there are practically two locations of this disease: one at the pylorus, involving the biliary and pancreatic glands; and the other in the colon, particularly in its sigmoid portion. In Zemann's collection from 21,624 autopsies there were 1,744 carcinomas, 912 of which were in the intestinal tract, 37 in the tongue, 34 in the pharynx, 136 in the esophagus, 540 in the stomach, 3 in the duodenum, 6 in the ileum, and 144 in the lower bowel, distributed as follows: 12 in the cecum, 1 in the appendix, 32 in the colon, 30 in the sigmoid region, and 81 in the rectum.

Carcinoma of the intestinal tract is generally single and solitary. Only rarely do multiple carcinomas appear. Küttner, however, in one case observed 155 separate foci in the small intestine. In some cases of carcinoma in the upper portion of the intestinal tract multiple carcinomas subsequently appear in the intestine and in the general peritoneal cavity.

If now we take the frequency of abdominal carcinoma alone from all the available statistics and form a table, we have the following:

	Autopsies.	Carcinomas.	Stomach.	Duodenum.	Jejunum.	Ileum.	Appendix.	Cecum.	Colon.	Sigmoid.	Rectum.
Zemann	21624	1744	540	3	0	6	1	12	32	30	81
							Total, 75				
Maydl	20480	1460	a	2	0	4	1	9	23	13	48
							Total, 46				
Nothnagel ...	21358	2125	a	5	0	6	1	14	36	40	114
							*Total, 118				
Heimann	a	20544	4288	a	0	20	a	a	a	49	1204
							*Total, 224				
Totals		25873	4828	10	0	36	3	35	91	132	
							*Total, 463				

a—not available.
*Totals are including material not in this table.

The natural tendency of a carcinoma beginning in the mucosa is to attach itself firmly to the muscularis, and thus produce an annular constriction of the gut. This constriction produces symptoms of the greatest diagnostic value, and in proportion as the stricture is rapid and complete, the hope of an early diagnosis and a favorable result from treatment is increased. The tumor spreads over the mucosa, infiltrates the muscularis, and obstructs peristalsis. Early ulceration takes place, with the discharge of blood and the opening of an area of pyogenic infection. Thus two

new symptoms are added to those essential to the diagnosis of the disease. The recognition of blood in the stool is more likely the nearer the carcinoma is to the anus. The symptoms of infection depend upon the extension of the infection from the ulcerated mucosa through the lymph channels to the peritoneal cavity, and the onset of a localized peritonitis. Only occasionally does the ulcerative process involve the muscularis and through peristaltic movements terminate in perforation into an adjoining intestine, the stomach, urinary bladder, or in the general peritoneal cavity. This event sometimes results in great improvement in the symptoms when an anastomosis is formed; or on the other hand, as a result of perforation, the end comes in a general peritonitis, which is sometimes the very first symptom of the disease.

The number of secondary carcinomas of the intestinal tract is unmentionably small, and this condition plays a very trifling part in diagnosis and surgical treatment. In a few instances carcinoma of the upper abdominal region is widely disseminated below, and pelvic carcinoma sometimes spreads to the adjoining intestines. Rarely there is more than one apparently primary focus in the intestine.

Men and women suffer of intestinal carcinoma with equal frequency, but carcinoma of the anus and rectum is much more common among men.

The mucous membrane is usually the primary site of the disease, and this is probably the reason that most cases of intestinal carcinoma are adenocarcinomas.

The most unfavorable carcinomas for diagnosis and treatment are those which begin in the mucosa

and lie dormant there, but produce mesenteric carcinomas early in the progress of the disease. Equally unfavorable for diagnosis are those that destroy the mucosa without producing constriction and symptoms of obstruction. Such tumors may continue for months or years, until by obstructing the portal circulation, or the arterial or venous circulation of the intestine, the gut suddenly undergoes an extensive anemic or congestion necrosis. A case of this kind presented symptoms which led to a diagnosis of appendicitis with obstruction, and on opening the abdomen more than three feet of the ileum, reaching from the ileocecal valve oralward, was completely gangrenous and black, and the mesentery contained a carcinoma which involved and obstructed all of the lower intestinal branch of the superior mesenteric artery and the accompanying vein.

The clinical picture which is presented by cases of carcinoma of the colon is rather vague and indistinct. The patient is in middle or advanced life; he has perhaps been the victim of some intestinal disorder which gave symptoms of ulceration of the bowel or dysentery, usually early in life. For a few months or a year he has been troubled with constipation, flatulency, and a vague and indistinct abdominal distress, somewhat similar to that which follows the use of calomel on a full stomach. During a more recent period of a few weeks he has lost strength, assumed a yellowish or cachectic color, and has lost from five to twenty pounds in weight. He usually thinks his loss of appetite and dyspepsia sufficient to account for the loss of weight. The muscles of his arms and legs are

to him inexplainably shrunken and flabby. He has noticed a distinct loss in sexual power and interest in life. On two or three occasions there has been a severe griping, abdominal pain coming on five or six hours after a meal, and attended by a peculiar sensation of fullness in the abdomen, and even by a feeling of movement in the external abdominal wall. If the patient is examined at such time, a distinct rising and falling of the abdominal wall can be seen and felt, which terminates at the location of the obstruction in the gut. After a time these abdominal movements become almost daily occurrences, and even persist the day and night through, with tympanites, abdominal distress, dyspnea, and at last vomiting and relative relief. After a protracted attack of vomiting the obstruction apparently gives way; the contents of the colon escape, with much flatulency and sometimes with a show of blood; the abdominal walls become flaccid, and if an examination is made a very distinct and movable tumor, somewhat resembling a kidney in size and motility, can be felt through the abdominal wall. It is tender, and later infection of the eroded mucosa begins and the tumor is surrounded by an area of peritonitis. If this tumor be found in the region of the ileocecal valve, it may give rise to a suspicion of appendicitis. This is especially the case after ulceration and infection have taken place, and the symptoms of a localized peritonitis, with a high temperature, a rapid pulse, and a hyperleucocytosis, are present. In a few instances the patient complains only of the fetus-like movements within the abdomen. and if the patient is a woman she is some-

times deceived into thinking that she is pregnant, or the movements are followed by the gurgling and whistling of gas, which is so conspicuous as to prevent the patient from enjoying the ordinary associations of life. The vomiting of greenish fluid, and the complaint of the patient that there is a fecal taste in the mouth and in the vomited matter, ought to arouse the suspicion of carcinoma. The appearance of blood and pus in the discharges is not uncommon. The pus arises from the pericecal peritonitis, and breaks through the ulcerated gut and is discharged.

In another instance, an apparently healthy woman is suddenly seized with the symptoms of obstruction. For the first time a vaginal examination is made, and a large fibroid tumor of the uterus discovered, which is so situated as to reasonably explain the origin of the obstruction. Palliative measures are used for a few hours, and when the abdomen is opened the actual cause of obstruction is discovered in the complete obliteration of the sigmoid colon by carcinoma.

When the carcinoma is medullary, it fails to give rise to symptoms of obstruction, but it early gives rise to melena, and the presence of the growth should be suspected in spite of the frequency with which old people are troubled with bleeding piles. The extension of an intestinal carcinoma is usually very slow; it proceeds by the lymph glands, toward the mesenteric lymph glands, and in a few instances the branches of the portal vein are eroded and penetrated by the carcinoma and particles of the tumor are carried to the liver. The great tardiness of lymphatic extension of carcinoma of the rectum and sigmoid colon has

been repeatedly observed, but there are histologic forms of carcinoma of the colon and rectum which are extremely rapid in their metastasis, and early result in carcinoma of the most distant organs of the body.

Most of the patients who suffer from carcinoma of the intestine are in advanced life and unwillingly present themselves to the surgeon for operative treatment. Their blood-vessels have already undergone sclerotic changes, and the kidneys are apt to show marked symptoms of disease. Very few men are free from prostatic trouble or from the complications which have resulted from their occupations or the excessive use of stimulants. Occasionally the diagnosis is masked by the presence of fluid in the general peritoneal cavity, and it is always confused by the flatulency and constipation which are apt to be present on the first examination.

The indications for operating upon a carcinoma of the intestine are as absolute as the diagnosis. Every case of intestinal carcinoma in which a reasonable diagnosis can be made should be at once operated upon and the gut resected. The fact that the patient is suffering from diabetes or a chronic nephritis, the fact that the patient has a vulvular disease of the heart, the fact that he has a general arteriosclerosis, ought not to weigh against the decision. If any operative procedure promises relief, this fact can be discovered only after an abdominal section has been made. The localities in which the carcinoma appears most frequently are for the most part the locations in which operations are most difficult. Cecal carcinomas. and carcinomas of the colon offer the greatest

hope of a favorable result. Carcinomas of the pylorus, the duodenum, and the sigmoid flexure present anatomic difficulties to the operator which greatly diminish the prospects of a favorable issue. It is a pathologic fact of great surgical interest that the annular carcinomas of the intestine show little tendency to invade the adjoining lymph tissues, and when an excision has once been made the hope of a permanent recovery is very great.

The treatment of carcinoma of the colon is surgical from the start. As soon as the diagnosis has been made it should be confirmed by an exploratory laparotomy, and one of three methods of treatment, depending upon the condition and surroundings of the patient, instituted at once.

If the patient has been neglected until the obstruction is complete and the abdomen is distended and the colon stretched to the bounds of its strength, it is necessary to open the distended gut not more than eight to ten inches from the carcinoma, and attach it to the abdominal wall as a temporary artificial anus. After this procedure the tympanites quickly disappears, and if the operation has been done under a local anesthesia or the administration of gas, the appetite returns and the health and strength of the patient make a rapid improvement. At a subsequent operation more radical measures can be adopted. By this means the danger of peritonitis is greatly diminished. The distended intestine and the foul-smelling effusion which is always found in the peritoneal cavity in these cases is a distinct contraindication to any extensive operation.

The second surgical procedure, which is practiced when the oral side of the gut is not too greatly distended, consists in the formation of an anastomosis between the anal and the oral portions of the gut and the exclusion of the irremovable tumor. This is done in the ordinary way so that the peristaltic waves are carried directly from the oral to the anal portion. After this procedure has been completed, should the surgeon find the condition of the patient favorable, and the tumor accessible, he may then complete the operation by the removal of the tumor. This procedure is best adapted to carcinomas of the cecum. Carcinomas of the transverse colon or of the hepatic or splenic flexures, or those rare tumors of the ascending or descending colon, submit themselves to resection and end to end anastomosis.

On account of the sessile and immovable nature of most carcinomas of the cecum, an extensive incision is necessary through the abdominal wall in order to approach the tumor and make the anastomosis. If the diagnosis was accurately made before the operation, an incision on the outer border of the rectus will be found most favorable. The ileocecal fossa and the pelvic fossa should be filled with a large laparotomy sponge carried over the edge of the wound. The ileum, which is likely to be distended, should then be brought up and its contents stripped back and a clamp applied at a point favorable to its circulation. The ileum is now thrown in a loop so that its anal portion is turned upward and brought in contact with the median side of the colon three or four inches above the tumor. The mesenteric edges

of the ileum and colon are now firmly sutured for a distance of an inch and a half, and the ends of the suture brought for a quarter of an inch at both ends in a transverse direction. An incision is then made in the gut, and the suture closed, thus completing the anastomosis. A few additional stitches may be placed so as to hold the loop of ileum close to the colon and prevent any strain upon the suture. If the patient has stood this portion of the operation well, the excision of the carcinoma may be undertaken. If the operator decided in the beginning to make an excision of the tumor, a simpler, a more direct, and better method is the implantation of the ileum into the side of the colon.

The third surgical procedure is the ideal one. It consists in the removal of the tumor and the establishment of the integrity of the intestinal tract. The operator presumes that the tumor is movable, and it is approached by the most favorable incision. The patient is in such a condition as to stand the operation, and the intestinal tract is so empty, especially the oral portion of the gut, as to permit of resection. If the tumor is in the ileocecal region, the ileocecal fossa and the pelvic fossa are protected by sponges, the oral portion of the gut is emptied and clamped, a favorable point in the ileum is selected, the gut is cut off, and the mesentery is dissected out in such a way as to avoid injuring the lowest branch of the superior mesenteric artery, which supplies the lower twelve inches of the ileum. The colon is then clamped and amputated together with the appendix, the ileocecal valve, and the contained tumor, and all the lymph

tissues in the iliac fossa. At this point it may be found necessary to detect and follow the course of the right ureter, which is in close proximity to the mesentery of the appendix, colon, and first portion of the ileum especially after they have been modified by the infiltrating tumor. If the blood-vessels are picked up as the dissection is made and the larger ones ligated the hemorrhage is trifling. The amputated colon should then be closed and brought down in such a manner, if too much has not been sacrificed, as to cover the denuded portion of the dorsal pelvic wall. The amputated end of the ileum is then brought against the median side of one of the haustra of the colon, an incision is made in this haustra and the ileum is attached in the same manner as that described for circular resection under Connell's method. The operation is then completed by attaching very carefully the mesentery of the ileum to the median side of the amputated colon so that no hernia could escape between the colon and the ileum and no raw surfaces show themselves after the completion of the resection. No vigorous search for enlarged mesenteric lymph glands should be made in the mesentery of the ileum without a full recognition and protection of the lower branches of the superior mesenteric artery. In making the amputations great care should be exercised in selecting the spot so that the end of the gut will have an abundant arterial blood supply.

The excellent results which follow excision are illustrated by the following case diagnosticated by Dr. Arthur Edwards and operated upon by Dr. Weller Van Hook:

Mrs. H., the wife of a physician and the mother of one child, had been suffering for some weeks with abdominal distress and occasionally abdominal pain. For a considerable time she had had digestive disturbances, and it became increasingly difficult to secure passages of the bowels. The feces had latterly consisted of small masses. The patient was occasionally distressed with tormina, and considerable emaciation had occurred. The appetite was almost entirely gone, and she complained of a fecal taste in the mouth. Dr. Arthur Edwards had noticed a tumefaction in the epigastric region, and had diagnosticated carcinoma of the transverse colon. Dr. Weller Van Hook made an excision of the tumor with silk sutures, and the abdominal wound was closed without drainage. This operation was performed in mid-summer, and the extremely hot weather was so debilitating to the patient that the temperature of the room was lowered by placing blocks of ice about. Her recovery was slow but uninterrupted, and her health during the succeeding eight years has been excellent.

The tumor was a cylindrical celled carcinoma, which produced an unusually early constriction of the intestine.

Carcinoma of the vermiform appendix itself is probably not so rare a disease as the statistics would indicate. It was first recognized by Rokitansky, who reported four cases of primary carcinoma of the appendix in 1867. The literature shows other cases reported previously reaching back as far as 1838. Elting and Moschcowitz make collections and studies which are interesting and suggestive. They give a résumé of a large number of cases and append a valuable bibliography.

Carcinoma of the appendix does not play any considerable clinical rôle. The disease is one which appears rather early in life, and may be observed at any age. It shows a small tendency to metastasis and a

slow progress in the appendix itself. The symptoms of carcinoma are not diagnostic, and they resemble the symptoms of chronic appendicitis, sometimes with and sometimes without acute exacerbation. There seems to be some relation between chronic appendicitis, especially that of the obliterating type, and carcinoma. The fact that carcinoma is apt to appear in the chronically inflamed appendix does not detract from the indications for appendicectomy, but rather intensifies them. Up to the present time this variety of carcinoma has appeared almost three times as often in the female as in the male.

The pathologic findings of carcinoma of the appendix are not macroscopically very obvious. Most of the cases which have been observed were discovered after the removal of the appendix by close pathologic and microscopic study.

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ADAGES

Appendicitis granted, operate.—*Crutcher.*

The diagnosis of appendicitis is always relative.

Appendicitis is almost as common as belly-ache.

The dangers of appendicectomy itself are trifling.

The first duty of the doctor is to make a diagnosis.

Every operation for appendicectomy is exploratory.

The dangers of appendicitis in any stage are immeasurable.

Ideal appendicectomy in the interval should be performed under the best circumstances possible.

There is no time in the course of an infection from appendicitis when the life of the patient should be entirely despaired of.

A fecal taste with constipation suggests carcinoma of the colon, especially in the old and when accompanied by abdominal distention.

The indications for treatment of appendicitis are simple. The appendix should be removed and the removal should be done at once.

From a consideration of the symptoms and physical findings the course of any case of appendicitis cannot be predicted by the wisest clinician.

Ideal appendicectomy ought not to require more than an inch-and-a-quarter incision, ten minutes of anesthesia, and four days in the hospital.

In doubtful cases it must be emphasized that the dangers of operation per se are practically nil, and that the dangers of delay are terrible.—*Bonney.*

The rapid subsidence of symptoms within the first twenty-four or thirty-six hours is no indication that appendicitis is taking a favorable course.—*Murphy.*

Appendicectomy frequently cures gastritis, constipation, sick-headaches, and results in a taking on of weight and an increase in mental and physical vitality.

Acute appendicitis is a very misleading term. The most acute cases gradually verge downward into the most chronic cases without any line of demarcation.

There is no moment in the course of an appendicitis when the chances of the patient are not better with a skillful appendicectomy than under expectant treatment.

Every therapeutic measure other than appendicectomy which has been proposed or practiced has added to the confusion of the literature and the disaster of the patient.

Appendicectomy in the acute stage and drainage of periappendicular abscesses should be performed wherever the patient is discovered and without needless transportation

Remember that in the event of acute appendicitis, definitely and legitimately demanding operation on its own merits, complicating conditions furnish no contraindications.—*Bonney.*

Fecal fistula after the drainage of a periappendicular abscess is generally due to a perforated appendix with an obstructed valve of Gerlach, and appendicectomy is the only remedy.

The natural course of appendicitis is onward, progressive, and destructive. There is no safety in rest, starvation, and delay, but the gravest dangers of uncontrollable and irremediable disaster.

In all cases when operation is advocated it should be made clear, not that the operation is absolutely necessary for recovery, but that the chances for recovery are greater with than without it.—*Bonney.*

In all cases of appendicectomy for chronic appendicitis or operations in the interval, the most competent surgeon and the most perfectly equipped hospital should be placed at the command of the patient.

Pain in appendicitis must be looked upon as a serious symptom whenever it does occur, but its absence does not preclude the gravest danger, nor promise betterment for the patient as long as other symptoms remain.

The sordid interest of the physician may be conserved by the expectant treatment of appendicitis, by waiting for the interval, and by enemas and lavage, but the safety of the patient and the reputation of the profession never.

One can never feel very safe in operating for appendicitis which has been in an acute stage for a number of days. He must always feel the lurking possibility of a distant focus of infection at some distance from the appendix.

The absence of definite physical signs in the right iliac fossa in the presence of sudden chill, fever, nausea, acute abdominal pain, and prostration offers no reliable assurance of the non-existence of a most serious involvement of the appendix.—*Bonney.*

When the appendix is free in the general peritoneal cavity, or only attached to the surrounding viscera by old and attenuated adhesions, appendicectomy is at once the easiest, the most highly specialized, and the most simplified of all forms of laparotomy.

The duration of appendicitis is not measured by the duration of the symptoms of appendicitis. The symptoms of appendicitis do not make it possible to diagnose the stage of the disease, and therefore make a reliable prognosis, without or with appendicectomy.

Leucocytosis and its fluctuation is of great diagnostic and pathologic significance, but its absence is not proof that a chronic appendicitis does not exist, though with the presence of acute symptoms it might arouse a suspicion of cancer, tuberculosis, or typhoid.

Cancer, tuberculosis, and actinomycosis of the appendix are interesting pathologic rarities which have little or no clinical significance, and the possibility of their presence does not detract from the value of the clinical symptoms of suppurative appendicitis, but rather intensifies them as indications for appendicectomy.

The obligation of the patient to the surgeon who with the greatest skill cures the disease safely, quickly, and pleasantly is far less than to the physician who has the intuition, the scrupulous devotion, and the unflinching courage to insist upon surgical relief at the first red flag of danger, and before irremediable complications have developed.

There can be no greater reflection on the professional attainments and acumen of a physician than failure to recognize at once the precise nature of the disease and to prepare at the

earliest possible moment for surgical relief, and it is no compliment to him to summon surgical aid after a period of disastrous, fateful, and delusory expectancy.—*Bonney.*

It must be rare in a civilized community that the services of some person of experience in the use of anesthetics cannot be secured, but the wanton recklessness that coolly selects the stupidest of a group of assistants for the anesthetist, on the ground that anybody can give ether, can hardly be condemned sufficiently in moderate language.—*Crutcher.*

The fate of the patient usually depends on the details and accuracy of observation, the acuteness of diagnosis, definiteness of purpose, and the promptness of execution of the physician alone during the first twenty-four to thirty-six hours. According to the degree of medical intelligence and sagacity involved will the time either of surgical counsel or active operative interference be involved.

I think that any of the advocates of the treatment by rest will concede that the patient would be much better off with the appendix out, if it could be done without an operation. We have simply to weigh the dangers of the additional toxemia of the anesthetic and the shock of operation against the danger of continued infection, both systemic and peritoneal from the appendix itself or the escape of its contents.—*Blake.*

The physician who makes an early diagnosis of appendicitis and by his diplomacy secures a prompt and ideal appendicectomy, with only a few days of disability and trifling suffering of the patient, renders a far more valuable service and ought to receive a larger fee than the surgeon who skillfully performs the operation; how much more valuable a service then does he render than the deluded physician who hesitates in his diagnosis and after weeks of guidance under his watchful eye, with starvation, immeasurable pain, and risk of life, carries the patient over to relative spontaneous recovery, with moreover the embarrassing prospect of a complicated appendicectomy in the so-called interval.

INDEX OF NAMES

Allingham, 295.
Anders, 271.
Armstrong, 313.
Ashhurst, 318.
Babcock, 46, 71, 128, 129.
Bailey, 234.
Behla, 331.
Benda, 254.
Blake, 234, 278, 312.
Boas, 287, 297.
Bradley, 40.
Brainard Polyclinic, 40.
Braun, 298.
Breringer, 200.
Brittin, 117.
Brown, F. Tilden, 318.
Brown, John, 2.
Carlson, 127.
Churchill, 46.
Connell, 293, 294, 329.
Cooper, 250.
Crile, 252, 307.
Cullen, 238.
Cumston, 331.
Curschmann, 318.
Dandridge, 119.
Davies, 196.
Deaver, 247.
Diazo, 8. 156.
Doud, 298.
Douglas, 316.
Edson, 234.
Edwards, 329.
Eichberg, 120.
Elting, 330, 321.
Escher, 311.
Eskelin, 297.
Evans, 235.
Fehling, 157.
Fenger, Christian, 57, 59, 126.
Fisher, 314, 315.
Fitz, 281, 285.
Flint, 36.
Fowler, 63.
Fuchs, 82.
Galloway, 85.
Gant, 297.
Gates, 318.
Gibson, 281, 285, 291, 297.
Goodwin, 196.
Grawitz, 253.
Grissole, 12.
Habershon, 254.
Harris, 82.
Harte, 318.
Heimann, 2, 320.
Hektoen, 298.
Helm, 86.
Hemmeter, 298.
Herrick, 114.
Hessert, 200, 202.
Huntington, 25, 191.
Jones, Joseph P., 196.
Keen, 309.
Kemp, 236.
Küttner, 319.
Langenbeck, 2.
Larry, 2.
Lembert, 311, 316.
Lennander, 79.
Lichtenstern, 298.
Lieberkühn, 21.
Lister, 1.
McBurney, 13, 117 165, 173.
Maydi, 320.
Meckel, 141, 244.
Mikulicz, 196, 275.
Moschcowitz, 330, 331.
Murphy, 124.
Mynter, 72.
Nothnagel, 298, 318, 320.
Ochsner, 117.

O'Hara, 123.
Osler, 313.
Ouvry, 296.
Parker, 12.
Pasteur, 1.
Peabody, 234.
Pilz, 298.
Pott, 256.
Preble, 215.
Quine, 84.
Raycroft, 36.
Rokitansky, 330.
Schleich, 202, 208, 218, 310, 311.
Sells, 296.
Senn, Nicholas, 298.
Stengel, 318.
Treitz, 248.
Trendelenburg, 275.
Vanderveer, 331.
VanHook, 272 314, 329.
Virchow, 1.
Wainwright, 298.
Wells, 216, 217.
Wescott, 313.
Wherry, 216.
Widal, 9, 39, 109, 140, 153, 156.
Wiggins, 281.
Wilson, 85.
Wuerth, 49.
Zemann, 319, 320.

SUBJECT INDEX

Abdomen, 5.
  caudal portion of, 25.
  form of in appendicitis, 101.
  great fossæ of, 25.
  method of palpation in appendicitis, 135, 136.
  rigidity of, 7.
  surgery of, 1.
Abdominal disease,
  general symptoms of, 8.
    chills, 8.
    Diazo reaction, 8.
    leucocytosis, high, 8.
    malarial germ, 9.
    nephritis, acute, 9.
    peptonuria, 8.
    pulse, rise of, 8.
    rigors, 8.
    temperature, rise of, 8.
    Widal reaction, 9.
  signals calling attention to, 6.
  subjective symptoms of, 9.
    anorexia, 9.
    malaise, general, 9.
    nausea, 9.
    pain, 9.
    tenderness, 9.
Abdominal disorders, see
  constipation, 7.
  diarrhea, 7.
  dyspepsia, 8.
  gastritis, 8.
  indigestion, 8.
  tumors, 8.
Abdominal pain in peritonitis, 263.
Abdominal wall, closure of in appendicectomy, 179
  edema of in perityphlitic abscess 135.
Above, see cephalic, IX.
Abscess, distant from appendix, 49.
Abscess, gravity, in appendicitis, 52.
Abscess, inguinal, from appendicitis, 126.
Abscess, intraperitoneal, 191.
Abscess, periappendicular, 13.
  case of, 40.
  complications following, 195.
  complications in, 193.
  dangers of, 193.
  danger of peritonitis in, 204.
  dissection of, 237.
  drainage for, 194.
    iodoform poisoning in case of, 196.
  failure to close, 52.
  fistula, treatment of, following, 206.
  illustrative case, 53.
  incision for, 193.
  iodoform poisoning, 196.
  operation for, 193.
  postoperative treatment for, 194.
  protective adhesions in, 48.
Abscess, perityphlitic, 49.
  compared to puerperal sepsis, 193.
  dangers of, 116.
  diagnosis of, 97
  edema of abdominal wall, 135.
  relatively rare, 60, 135.
  signs of, 134.
Abscess, subphrenic, 239.
  origin of, 239.
Abscesses, hypertrophy of tissues, 42.
Acetone, test for, 236.
Actinomycotic fungus, 14.
Age, in appendicitis, 47.
Anatomy
  of appendix, 18, 19.
  of peritoneum, 245.
Anemia—grave—in appendicitis.
  case of, 219.
  contra-indication for general anesthesia, 219.

Anesthesia
for appendicectomy, 208.
chloroform, 211.
two deaths after, 213.
ether, 211.
nitrous oxide, 210.
Anesthesia, general
dangerous in
acute nephritis in appendicectomy, 218.
alcoholism, 219.
bronchitis, 219.
diabetes, 220.
enlarged tonsil, 220.
exophthalmic goiter, 220.
goiter, 220.
heart lesions, severe, 219.
obesity, 219.
old age, 220.
pregnancy, 220.
pulmonary tuberculosis, 219.
uvula, long, 220.
Anorexia in abdominal disease, 9.
Anus artificial, for intestinal obstruction, 279.
Appendicectomy
of adherent appendix with abscess, 191.
of adherent appendix without abscess, 184.
after treatment, 180, 221.
baths in, 226.
cathartic in, 225.
dressing, 180.
enemas in, 223.
gastric lavage in, 225.
operation, infected stitches from, 227.
treatment of, 227
restoratives.
anodynes, withheld, 222.
gastric sedatives withheld, 222.
semirecumbent position in, 224.
vomiting after anesthetic, 225.
anesthesia, 208.
chloroform, two deaths following, 213.
Appendicectomy
appendix, adherent, postoperative treatment, 189.
appendix, how amputated, 176.
closure of abdominal wall, 179.
complications and sequelae, 228
appendicectomy, acetonemia following case of, 232.
acute dilatation of stomach after appendicectomy, 240.
acute nephritis, treatment of, 229.
adhesions, symptoms of, 238.
treatment, of, 238.
bronchitis, 230.
bronchopneumonia, 230.
cholangitis during appendicitis after appendicectomy, 240.
dependent on patient's condition, 229.
diabetes and acetonemia, 231.
parotitis in appendicitis after appendicectomy, 236.
pregnancy in appendicectomy, 230.
pregnancy in appendicitis, 230.
technical errors in appendicectomy, 237.
forceps in, 186.
of free appendix in acute appendicitis, 172.
of free appendix in chronic appendicitis, 172.
incision, 173.
with other operations, 205.
search for appendix in, 174.
Appendicitis, 5, 12.
acute and chronic, relationship, 109
acute, misleading term, 109.
acute obstructive, 20.
acute, prognosis in, 111.
acute, temperature in, 97.
in baby, 86.
backache in, 91
biliousness in, 92.
case of, 43.
cases—table 183.
catarrhal, 13.
chills significant in, 90

Appendicitis
with cholecystitis, 150.
chronic
acute attacks in, 110.
appearance of appendix, 62.
diminution of hemoglobin in, 100.
microscopic study of appendix in, 63.
remote systemic effects
gastric disturbance, 58, 59.
nervous disorders, 74, 75.
renal symptoms, 60, 61, 70.
typhoid state and pulmonary symptoms, 62.
symptoms of
gastralgia, 59.
hectic, 59.
hyperchlorhydria, 61.
neurasthenia, 59.
right peritoneal cavity tender, 62.
right rectus tense, 62.
colicky pain in, 16.
collapse in, 89.
complications possible, 105.
complications of neglected, 115.
as complication in typhoid, 306.
concretions in appendix, 27.
cough as a cause of, 28.
courageous surgery in case of, 200.
course of, 31.
typical histories of, 181.
unmodified by any measures other than operative, 112.
cutaneous hyperalgesia in, 95.
definitions of terms used, 13, 14.
diagnosis of,
always relative, 133.
differential, 140.
adult, 142.
adult over 45, 143.
carcinoma of the cecum, 167.
carcinoma elsewhere in abdomen, 168.
carcinoma of pylorus, 168.
impaction of feces, 169.
perivesicle abscess, 169.

Appendicitis
diagnosis of, differential
adult female:
abortion, 164.
ovarian tumor with twisted pedicle, 166.
prolapse of ovary, 160.
pyosalpinx of right tube, 165.
ruptured extrauterine pregnancy, 163.
tort of ureter of floating right kidney, 166.
in child, 142.
from acute dilatation of the stomach, 143.
cystic tumors, 149.
distended urinary bladder, 149.
general gastrointestinal infection, 145.
hernia, 149.
intussusception, 144.
ileocecal valve, objects impacted in, 149.
infection in Meckel's diverticulum, 148.
mesentery, tumors of, 149.
pneumonia, 146.
sarcoma of kidney, 149.
tuberculosis of the dorsal vertebrae, 147.
tuberculous peritonitis, 144.
urinary calculi, 146.
young adult:
abscesses in abdominal wall, 161.
acute miliary tuberculosis, 154.
acute pancreatitis, 157.
cholecystitis, 149.
gangrene of the intestine, 163.
gastralgia, 162.
gastritis, 162.
gastrodynia, 162.
hematomas in abdominal wall, 161.

Appendicitis
diagnosis of, differential
young adult:
hernia, incarcerated, reduced from inguinal ring, 161.
hernia in obturator foramen, 161.
hysteria, 162.
hernia in intraabdominal foramina, 161.
hernia in linea alba, 161.
locomotor ataxia, crisis of, 160.
mucous colitis, 150.
orchitis in undescended right testicle, 162.
perforation of bowel in typhoid, 154.
perforation of ulcer of stomach, 153.
tuberculous peritonitis, 154.
typhoid fever, 153.
ulcer of stomach, 151.
uremia, 163.
urinary calculus, passage of, 158.
young adult female, 142.
exploratory puncture, 139.
importance of history in, 134.
inspection, 135.
laparotomy, exploratory, 139.
methods of, 136.
palpation, 135.
X-Rays in, 135.
difficulties of prognosis in, 104.
duration of, 104, 105.
dyspepsia in, 92.
early idea of, 59.
etiology of, 27, 47.
fecal bodies in appendix, 27.
foreign bodies in appendix, 27.
form of abdomen in, 101.
gangrenous, added dangers in, 56.
illustrative case of, 57.
gastralgia in, 92, 162.
gastric neuralgia in, 92.
gastritis, 162.
gastrodynia, 92. 162.
Appendicitis
general and diffuse peritonitis from, treatment of, 205.
gurgling sound in region of appendix, 16.
headache in, 91.
historic notes, 12, 13.
inguinal abscess from, 126.
intoxication in, 91.
migraine in, 91.
mistaken for carcinoma of the colon, 84.
with mucous colitis, 151.
neglected cases of, 37, 117, 120, 129.
right suppurative pleuritis from, case of, 128.
neurasthenia in, 92.
objective symptoms of, 96.
obliterating, 13.
obscure forms of, 58.
palpation of abdomen in, 101.
partial, case of, 46.
peritonitis from, 259.
peritonitis from, without rupture of appendix, 55.
picture of pain in, 80.
present status of, 60.
protective adhesions in, 48.
recurrence in, 112.
responsibility of surgeon in, 133.
results uncertain, 105.
rigidity of right rectus, 10, 62, 137.
subjective symptoms, 16, 95.
subsequent attacks, 45.
suppurative, 13.
treatment of, 170, 241. See Appendicectomy.
dangers of delay in, 116.
danger of opium in, 202.
indications for, 113.
present tendency in, 113.
tuberculous, 14.
and typhoid, 109.
with typhoid, 154, 306.
Appendicular actinomycosis, 14.
Appendix, abnormal position, 28.
adherent, appendicectomy of, 185, 188.

Appendix, adherent
case of, 190.
tampon in, 188.
two conditions of, 184.
amputation, 176.
anatomy, 18, 19.
attachments of distal end, 26.
blood supply, 19.
blood vessels, 38.
carcinoma of, 330.
complete obstruction, 31.
constrictions, 46.
embryonal position, 24.
enlarged lymph glands of, 186.
fetal anatomy, 18.
in femoral hernia, 26.
histology of, 20.
in hernial sac, 26.
in inguinal hernia, 26.
innervations, 19.
location of, 24, 25, 26.
loose in abscess, 56.
lymph glands, enlargement of, 186.
lymph vessels, 19, 20.
lymphoid follicles, 21.
mesenteric veins, 20.
mesenteriolum, 18.
obliterated, 87.
perforation of serosa, 38.
peritoneal infection without rupture, 48.
illustrative case of, 49.
peritoneum of, 19.
relation of the muscular elements of, 28.
retention cyst of, 31.
rupture of, 38.
surgical anatomy of, 173, 174.
thrombosis of veins of, 30.
ulcer of mucous membrane, 45.
veins of, 19.
thrombosis of, 30.
Artery, superior mesenteric, 19.
Autopsy in vivo, 1.
Bacillus, colon, 14.
Back, see Dorsal, IX.
Backache, 91.
Bacteria in peritonitis, 242.
Below, see Caudal, X.
Bibliography, appendicitis, 241.
Carcinoma of intestinal tract, 331.
intussusception, 297.
perforating typhoid ulcer, 318.
peritonitis, 280.
Biliousness, 92.
Bowel, paralysis of in peritonitis, 264, 267.
Carcinoma of:
appendix, 14, 330.
colon, 84.
clinical picture, 322.
ideal operation for, 328.
surgical procedure in, 326.
intestinal tract, 319.
bibliography, 331.
indications for operation in, 325.
location of, 319.
statistics of, 319.
table of statistics, 320.
Caudad, X.
Caudal, X.
Caudal peritoneal cavity, 247.
Cecum, 18.
Cecum primitive, 18.
Cellular pathology, Virchow's, 1.
Cephalad, X.
Cephalic, X.
Cephalic peritoneal cavity, 247.
Charcot's triangle, 151, 152.
Charity hospital, 253.
Chemic peritonitis, 254.
treatment of, 269.
Chill in abdominal diseases, 8.
in appendicitis, 90.
Chloroform
death on table from, case of, 213.
method of administration, 212.
two deaths after in appendicectomy, 213.
Clinical courses, neglected appendicitis, 37.
Colicky pain in appendicitis, 16.
Collapse in appendicitis, 89.
Colon:
carcinoma of, 84, 322, 326, 328.
haustra of, 18

Common duct, peritonitis from, 259.
Conclusions, 241.
Concretions in appendix, 27.
Constipation in abdominal diseases, 7.
Cook County Hospital, 2.
Cooper's hernia, 250.
Diagnosis:
  appendicitis:
    importance of history in, 134.
    inspection, 135.
    method of, 136.
    palpation, 135.
    X-Rays in, 135.
  carcinoma of colon, 322.
  intussusception, 290.
  perforation in perforating typhoid ulcer, 304, 308.
  peritonitis, 268.
Diarrhea in appendicitis, 7.
Diazo reaction, 8, 156.
Distress in appendicitis, 16.
Dorsad, IX.
Dorsal, IX.
Douglas' cul-de-sac, 316.
Drainage in peritonitis, 275, 279.
Dyspepsia, 8.
  in abdominal disease, 92.
  in appendicitis, 92.
Early pains in appendicitis, 6.
Embryologic development of peritoneum, 247.
Embryonal position of appendix, 24.
Ether, disadvantages of, 212.
Faint feelings, appendicitis, 16.
Fallopian tubes, peritonitis from, 259.
Fecal bodies in appendix, 27.
Fecal taste in carcinoma of colon, 324.
Fehling's solution, 157.
Femoral hernia, appendix found in, 26.
Foramen, Treitz's, 248.
Foramen, Winslow's, 141, 248, 260.
Forceps in appendicectomy, 186.
Foreign bodies in appendix, 27
Fossa, duodenojejunal, 248.
  ileocecal, 249.
  ileocolic, 249.
  intersigmoid, 249.
Front, see ventral, IX.
Gall-bladder, 6, 10.
  peritonitis from, 259.
Gastralgia in appendicitis, 59, 92.
Gastric neuralgia in appendicitis, 92.
Gastritis in appendicitis, 8, 92.
Gastrodynia in appendicitis, 92.
General anesthesia, contra-indications to in appendicectomy, 218.
Gerlach, valve of, 14.
  absolute obliteration of, 55.
  complete obstruction of, 17.
Gurgling sound in region of appendix in appendicitis, 16.
Haustra of colon, 18.
Headache in appendicitis, 91.
Hectic in appendicitis, 59.
Hemoglobin, diminution of in chronic appendicitis, 100.
Hepatitis in peritonitis, 38.
Hernial sac, appendix in, 26.
Histology of appendix, 20.
Histology of peritoneum, 245.
Hospital, Cook County, 2.
Hospitals, German, 2, 3.
Hyperalgesia, cutaneous, in appendicitis, 95.
Hyperchlorhydria in appendicitis, 61.
Hyperleucocytosis in appendicitis, 16.
Ileocecal fossa, 249.
Ileocecal mesentery, 25.
Ileocolic fossa, 25, 249.
Ileus, 4.
Iliac vessels, position relative to appendix, 25.
Incision in appendicectomy, 173.
Indigestion in abdominal disease, 8.
Infection of peritoneum, 256.
Inguinal hernia, appendix in, 26.
Intersigmoid fossa, 249.
Intestinal mesenteries, limiting factor in peritonitis, 267.
Intestinal obstruction, artificial anus, 279.
  in peritonitis, 279.
Intestinal tract, carcinoma of, 319.
Intoxication in appendicitis, 91.

Intussusception, cases of, 295.
complicated by appendicitis, 294.
described, 281.
diagnosis of, 290.
etiology, 282.
frequency, 281.
inspection of abdomen, appearance of tumor, 289.
literature, 297.
operation, 292.
pain, 288.
pulse, 289.
prognosis, 291.
stool, character of, 286.
symptoms, 287.
temperature, 289.
typical case of, 285.
vomiting, 288.
Iodoform poisoning from drainage, 196.
Johns Hopkins, 274.
Kemp's tube, 236.
Laparotomies, 4.
Laterad, X.
Lateral, X.
Lembert's suture, 311, 316.
Leucocytosis, after operation, 100.
high, 8.
in appendicitis, 99.
in peritonitis, 265.
Lieberkühn, crypts of, 21.
Liver, acute yellow atrophy of, 213.
cases resembling, 213.
Lymphadenitis, 17.
Lymphangitis, 17.
Lymphoid nodules, 22, 23.
McBurney's point, 13, 117, 165, 173.
Malaise, general, in abdominal disease, 9.
Manikin, pathologic, 10.
Meckel's diverticulum, 141, 244.
Medad, X.
Medial, X.
Mesenteriolum of appendix, 18.
Mesocolon, limiting factor in peritonitis, 267.
Migraine in appendicitis, 91.
Mikulicz drain, 196, 275.
Murphy button, 124.
Muscle, right rectus abdominis, 8–10.
rigidity of in appendicitis, 62, 137.
Nausea in appendicitis, 9, 10, 16, 88, 89.
Nausea, faintness analogous to, 89.
Nausea sometimes absent, 89.
Nelaton's catheter, 125.
Nephritis:
acute in abdominal disease, 9.
contra-indication to general anesthesia, 218.
in peritonitis, 38, 264.
Neurasthenia in appendicitis, 59.
case of, 92.
Obturator hernia, appendix in, 26.
Omentum, motionless, limiting factor in peritonitis, 267.
Ovaries, attached to appendix, 26.
Ovary, veins of communicating with veins of appendix, 19.
Pain:
in appendicitis, 9, 10, 17, 78, 79, 80, 84, 87.
not invariable, 79.
quality of, 84.
sudden disappearance of, 83.
in peritonitis.
Palpation in appendicitis:
for rigidity of abdominal wall, 102.
for tenderness, 102.
Paralysis of bowel in peritonitis, 267.
Pathology, Cellular, Virchow's, 1.
Peptonuria in abdominal disease, 8.
Perforating typhoid ulcer;
diagnosis of, 304, 308.
operation, cases of, 314.
perforation:
frequency, 302.
operation described, 309.
site of, 303.
treatment of, 309.
perforations:
number of, 303.
size of, 303.
prognosis after operation, 313.

Perforation in typhoid ulcer, diagnosis of, 304, 308.
Periappendicitis, 13.
Periappendicular peritonitis, 13.
Peristalsis in peritonitis, 266.
Peritoneal cavity:
  caudal or lower, 247.
  cephalic or upper, 247.
  dissemination of infection, factors in, 265.
  general, rupture of appendix into, 105.
  lesser or little, 248.
  limitation of infection, 267.
  relation to infection, 244.
  tendency of infection in, 265.
Peritoneal shock in appendicitis, 16.
Peritoneum:
  anatomy of, 245.
  anatomy of adult, 247.
  caudal or lower, 247.
  Cephalic or upper, 247.
  embryology, 247.
  extent, 246.
  minute anatomy, 245.
  nerve supply, 252.
  physiologic activity, 250.
  physiologic relations, 243.
  reaction to infection, 256.
  sensation in, 252.
Peritonitis, 17, 55.
  abdominal pain, 263.
  from appendicitis without rupture of appendix, 55.
  atrium of infection, 259.
  bacteria in, 242.
  chemic origin, 254.
  course of, 265.
  danger of in transportation of patient, 204.
  diagnosis of, 268.
  differential diagnosis of, 268.
  diffuse, 38.
  dissemination:
    by capillary attraction, 265.
    by extent of effusion, 266.
    by gravity, 266.
    by peristalsis, 266.
Peritonitis
  effusion, 264.
    character of, 258.
  etiology of, 253.
  explanation of, 257.
  descriptive terms used,
    adhesive peritonitis, 258.
    dry peritonitis, 258.
    fibrinous peritonitis, 258.
    limiting peritonitis, 258
    obliterating peritonitis, 258.
    serous peritonitis, 258.
    peritonitis sicca, 258.
    suppurative peritonitis, 258.
  factors in dissemination, 265, 266.
  factors in, 243.
  fibrinous, adhesive, 267.
  forms of, 242, 280.
    circumscribed, 257.
    diffuse, 257.
    general, 257.
    local, 257.
  general, 99.
  general septic, 38.
  hepatitis in, 38.
  intestinal mesenteries in, 267.
  intestinal paralysis in, 264.
  leucocytosis in, 265.
  limiting factors in, 267.
  nephritis in, 38, 264.
  omentum in, 267.
  onset of, 263.
  other sources of, 260.
  paralysis of bowel in, 264, 267.
  peritoneal cavity relatively immune, 244.
  scheme of sources of, 261.
  signs of, 134.
  sorts of infection in, 255.
  source of:
    appendix most common, 259.
    common duct, 259.
    Fallopian tubes in females, 259.
    gall-bladder, 259.
    probabilities, 260.
    uterus in females, 259.
  sudden general, fatal, 105.
    cases of, 105, 107.

Peritonitis
tendencies of, 265.
terms used in, 258.
traumatic, 254.
tubercle bacillus in, 257.
urine in, 264.
vomiting, 263.
Peritonitis, acute:
clinical picture of, 261.
Peritonitis, chemic:
treatment of, 269.
Peritonitis, diffuse and general:
after treatment, 275.
from appendicitis, treatment of, 205.
intestinal obstruction, 279.
artificial anus for, 279.
prognosis of after surgical treatment, 276.
prognosis in, 273.
surgical treatment of, 274.
closing without drainage, 279.
drainage, 275, 278.
irrigation, 278.
various methods, 273.
Peritonitis, suppurative:
treatment of, 270.
other measures, 272.
saline cathartics in, 270.
semi-recumbent position in, 275.
Peritonitis, traumatic:
treatment of, 269.
Perityphlitis, 4, 13, 99.
Physiology of peritoneum, 243, 250.
Portal circulation, overdistention of, 47.
Portal system, 19.
Posture in appendicitis, 96.
Pre-antiseptic period, 2.
Probabilities of disease, 11.
Pulse:
in appendicitis, 96, 98, 99.
in peritonitis, 262.
rise of, 8.
Rectum, 26.
Rectus abdominis, 10.
Retention cyst of appendix, 14, 17.
complete obstruction, 34.
Retention cyst of appendix
production of, 28.
rupture of, 42.
symptoms of complete obstruction, 33.
ulceration of, 42.
Retrocecal fossa, 25.
Retrovesical pouch, 26.
Right rectus, rigidity of, 34, 62.
Right peritoneal cavity tender in appendicitis, 62.
Right tube, disease of, 48.
Rigors in abdominal disease, 8.
Riva Rocci sphygmomanometer, 307.
Rochelle salts, 271.
Schleich's solution:
dangers of, 210.
method of using, 209.
prescription for, 209.
Shoulder, right, pain in, 10.
Sigmoid flexure, 26.
Simon, kidney incision, 201.
Sources, peritonitis, scheme of, 261.
Stenson's duct, 237.
Stomach, pain in pit of, 10, 16.
Stomach, distress in pit of, 79.
Subperitoneal hernias, 26.
Suppuration in antrum of Highmore, 59.
Suppurative peritonitis, treatment of, 270, 271.
Temperature:
rise of in abdominal disease, 8.
in appendicitis, 97.
in peritonitis, 262.
Tenderness of abdomen in abdominal disease, 9, 17.
Teniae coli, 18.
Thorax, 5.
Traumatic peritonitis, 254.
treatment of, 269.
Tubercle bacillus, 14.
Tuberculous peritonitis, 257.
Tumors, 8.
Treitz's foramen, 248.
Tympanites in appendicitis, 17.
Typhoid:
appendicitis as complication, 306.

Typhoid:
statistics of, 299.
Typhoid, ulcer, perforating:
diagnosis of, 304, 308.
perforation:
cases, 314.
diagnosis of, 304, 308.
errors in, 306.
frequency, 302.
operation for, 309.
site of, 303.
size of, 303.
treatment of, 309.
perforations, number of, 303.
prognosis after operation, 313.
Ulcer, perforating typhoid:
diagnosis of, 304, 308.
operative cases, 314.
perforation:
diagnosis of, 304, 308.
errors in, 306.
frequency, 302.
operation described, 309.
Ulcer, perforating typhoid:
perforation:
site of, 303.
size of, 303.
treatment of, 309.
perforations:
number of, 303.
prognosis after operation, 313.
Urinary bladder, 26.
Urine in peritonitis, 264.
Uterus, 26.
adnexa of the, 10.
peritonitis from, 259.
Veins, mesenteric, thrombosis of in appendicitis, 20.
Ventrad, IX, 26.
Ventral, IX.
Vermiform appendix, see appendix, 18.
Vomiting, 6, 16, 17, 88, 89.
peritonitis, 263.
Widal reaction, 9, 39, 109, 140, 153, 156.
Winslow, foramen of, 141, 248, 260.

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